DOCUMENT RESUME

ED 428 780 IR 057 333

AUTHOR	Chambers, Jay C.; Vergun, Robert
TITLE	Measuring Inflation in Public Libraries: A Comparison of Two Approaches, the Input Cost Index and the Cost of Services Index. Statistical Analysis Report.
INSTITUTION	American Institutes for Research, Washington, DC.
SPONS AGENCY	National Center for Education Statistics (ED), Washington, DC.
REPORT NO	NCES-1999-326
ISBN	ISBN-0-16-050001-X
PUB DATE	1999-04-00
NOTE	100p.
AVAILABLE FROM	U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328; ED Pubs, P.O. Box 1398, Jessup, MD 20794-1398; Tel: 877-433-7827 (Toll Free).
PUB TYPE	Numerical/Quantitative Data (110) -- Reports - Research (143)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Budgeting; *Cost Indexes; Costs; *Inflation (Economics); *Library Expenditures; Library Funding; Library Services; *Library Statistics; *Measurement Techniques; *Public Libraries; Tables (Data)

ABSTRACT

This report presents two approaches to measuring inflation for public libraries: (1) an approach based on a fixed-market-basket (FMB) of the prices of library inputs, which yields a public library input cost index (PLICI), and (2) an approach based on an econometric model of library services and costs, which yields a public library cost of services index (PLCSI). The PLICI represents essentially a weighted average of the series of public library input prices, while the PLCSI places emphasis on the cost of producing library services. Contains the following chapters: Chapter 1 "Introduction"; Chapter 2 "Conceptual Framework" which describes the PLICI and the PLCSI approaches in some detail. Chapter 3 "Empirical Analysis of a Public Library Input Cost Index" offers an empirical analysis of the PLICI, including an analysis of budget shares and input cost series. Chapter 4 "Empirical Analysis of Public Library Operating Expenditures and Development of the Public Library Cost of Services Index" presents the PLCSI. Chapter 5 "Concluding Remarks" concludes the report by comparing the inflation index derived from the PLCSI with that from the PLICI and suggests ways of improving the public library indexes. Thirty-two tables and indexes present statistics. A glossary is provided. Appendices include technical notes, various descriptive statistics and parameter estimates for the variables used in the regression analysis, and standard errors. (AEF)

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Statistical Analysis Report April 1999

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Measuring Inflation in Public Libraries: A Comparison of Two Approaches, the Input Cost Index and the Cost of Services Index

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Suggested Citation

U.S. Department of Education. National Center for Education Statistics. *Measuring Inflation in Public Libraries: A Comparison of Two Approaches, the Input Cost Index and the Cost of Services Index*, NCES 1999–326 by Jay C. Chambers and Robert Vergun. Project Officer: Adrienne Chute. Washington, DC: 1999.

For ordering information on this report, write:

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ED Pubs
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Content Contact:
Adrienne Chute
(202) 219–1772

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-050901-X

Acknowledgments

The authors would like to acknowledge the contributions of Keith Lance, of the Colorado State Library, and the FSCS Data Use Subcommittee members who suggested the idea for developing a public library input cost index. Kent Halstead, of the Research Associates of Washington (RAW), also deserves recognition for the consultation and guidance provided at an early stage in the development of this project. The authors extend their gratitude to Dr. Halstead, who gave permission to the American Institutes for Research (AIR) to utilize the taxonomy developed for the budget share analysis contained in this report.

In addition, the authors would like to express their gratitude to the other members of the advisory committee who provided comments on the analysis plans and final report for this project. These individuals include Ann Prentice at the College of Library and Information Services, University of Maryland; Carrol Kindel, of the U.S. Department of Education (ED), National Center for Education Statistics; Mary Jo Lynch, of the American Library Association; William Fowler, of the U.S. Department of Education, National Center for Education Statistics; Ed Lakner at the Graduate School of Library and Information Science, University of Illinois-Urbana-Champaign; Chris Dunn, of the U.S. Department of Education, National Library of Education; Mark Sherwood, of the U.S. Department of Labor, Bureau of Labor Statistics; Jane Robbins at the School of Information Studies, Florida State University; and Al Zimmerman, of the Wisconsin Department of Public Instruction for Libraries and Community Learning.

The authors would also like to thank the U.S. Department of Education's Library Programs, which along with the National Center for Educational Statistics (NCES), contributed some financial support to the project.

The authors would like to express their appreciation for the valuable comments and contributions of Don McLaughlin and Jean Wolman, of AIR, to this report. Dr. McLaughlin's suggestions improved the analysis and presentation of the information. Ms. Wolman provided detailed editing of this manuscript which contributed in important ways to its readability.

The authors would like to thank Ann Win and Bob Morris, both of AIR, who provided the programming support involved in the development of the analysis database. Others at AIR who have contributed in the production of this report include Shannon Daugherty, Grace Wu, and Chris Martin.

The authors would especially like to thank Mary Anne Arcilla. She provided support above and beyond the call of duty to assist us in completing the last few drafts of this manuscript and in the process of making the final edits based on the final adjudication of the report.

The authors would also like to acknowledge the contributions made by the NCES project officer for this task, Adrienne Chute, as well as the NCES reviewers, Marilyn McMillen, Roslyn Korb, Mike Cohen, and Bill Hussar for their careful review of the draft manuscript. Their comments improved the quality and clarity of the presentation. In addition, we would like to acknowledge the contributions of the outside reviewer Gerry Roland and ED reviewer Barbara Humes for their valuable suggestions.

Highlights

This report presents two approaches to measuring inflation for public libraries: (1) an approach based on a fixed-market-basket (FMB) of the prices of library inputs, which yields a public library input cost index (PLICI), and (2) an approach based on an econometric model of library services and costs, which yields a public library cost of services index (PLCSI). The PLICI represents essentially a weighted average of the series of public library input prices, while the PLCSI places emphasis on the cost of producing library services.

- During the period from 1989–90 to 1992–93, the PLICI created by the American Institutes for Research (AIR)—PLICIa—shows an average annual rate of inflation of 4.3 percent. In contrast, the PLCSI exhibits an average annual inflation rate of 3.9 percent during that same period. For comparison purposes, household consumer prices rose at an average annual rate of 3.9 percent, while producer prices rose at 2.4 percent over this same period.

- The PLICIa estimates of annual inflation rates based upon the FMB approach show roughly similar patterns of decline between 1989–90 to 1992–93 as the annual inflation rates based upon the Consumer Price Index (CPI).

- Inflation rates derived from the cost of services model show lower average annual rates of inflation (3.0 percent) than those derived using the FMB approach (4.3 percent). This is consistent with the expectation that the cost of services model should control better for increases in the costs of library services due to improvements in the level of services or technological change.

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Executive Summary

In an age of tight federal, state, and local government budgets, it is essential for officials in public agencies to have full and accurate information about the cost of providing public services. Public libraries are among those agencies that purchase a wide range of goods and services, and like other public agencies, they need to understand their costs of operation and justify requests for increases in funding. Over time, increases in costs result, at least in part, from inflationary pressures that affect the economy in general. Therefore, to allow meaningful comparisons of library revenue and expenditures over time, it is important to adjust reported dollars by an appropriate inflation index. However, use of the standard Consumer Price Index (CPI) for this purpose is insufficient because libraries purchase different goods from those purchased by typical households.

One source of information on public library expenditures is the Public Libraries Survey, conducted annually by the National Center for Education Statistics (NCES). This survey utilizes data collected from each state through the Federal-State Cooperative System for Public Library Data (FSCS). However, because these data are not indexed for inflation, the true impact of inflation on public libraries cannot be assessed. For example, one cannot determine whether the increases in total library revenue that have been shown by FSCS data in recent years led to increases in services or were consumed by inflation.

Two Approaches to Developing an Index of Inflation for Public Libraries

This report presents two approaches to measuring inflation faced by public libraries: (1) an approach based on a fixed-market-basket (FMB) of the prices of library inputs (i.e., prices of goods and services purchased by libraries, including personnel), which yields a public library input cost index (PLICI), and (2) an approach based on an econometric model of library services and costs, which yields a public library cost of services index (PLCSI). The PLICI represents essentially a weighted average of the series of public library input prices, while the PLCSI places emphasis on the cost of producing library services. The report presents estimates of public library inflation derived from each approach and compares each in terms of its advantages and disadvantages.

Fixed-Market-Basket Approach

The FMB approach produces an index that is a weighted average of the indexes of the prices of library inputs. This approach uses a methodology similar to that employed in the development of the standard CPI. The standard CPI is essentially an index of the differences in the prices of consumer goods

and services between two points in time, weighted by the typical basket of goods and services consumed by households during a base time period. Similarly, the input cost index developed in this report, using the FMB approach, is an index of the differences in the price of library inputs between two points in time, weighted by the typical basket of inputs purchased by libraries. This approach relies on a variety of data sources for the various price data that make up the public library input cost index. Using this methodology, one can determine a weighted average rate of inflation in the prices of these library inputs, where the weights used to aggregate these individual inputs are the average proportions of public library budgets (i.e., the budget shares) allocated to each input category. These weights or budget shares simply measure the importance of each input in the overall budget for public library operations. This report refers to the inflation index derived using the FMB as the public library input cost index (PLICI).

Public Library Cost of Services Model

This approach is based on a model of public library services similar to models used by economists to analyze the costs of production in any goods or service industry.[1] It is represented by an econometric model of the systematic patterns of variation in library expenditures over time. In addition, the model controls for cost variations associated with changes in the level of library services such as circulation, reference transactions, and library visits, as well as differences in geographic location. By controlling for variations in various types and levels of services rather than holding input levels fixed, this econometric model permits the inflation rates to take into account the effects of input substitutions and technological changes in the cost of doing business for libraries. The phrase "input substitutions" refers to the notion that those in charge of library operations will substitute away from utilizing relatively more expensive inputs toward the use of less expensive inputs over time to maintain service levels at the minimum possible cost. The phrase "technological change" involves improvements in service levels (or reductions in costs with no diminution in services) that may arise, for example, from the use of computer technology or other time-saving procedures or devices. This cost of services model primarily uses a single data source—the NCES FSCS data on public libraries. This report refers to the inflation index derived using this cost of services model as the public library cost of services index (PLCSI).

Comparing the Fixed-Market-Basket Approach and the Cost of Services Model

Each approach involves certain assumptions about the way public libraries operate and each contains limitations in the way cost data may be interpreted. In addition, the data requirements for using each model differ significantly, and the quality of the data used in calculating each varies considerably. A major difference between the two approaches is the clarity of what underlies the two indexes. Using the fixed-market-basket model to derive the PLICI, one can see and more easily understand the data components, such as the cost indexes of the various inputs and the budget shares used to aggregate them into a single index. Moreover, this methodology may be familiar to those who are aware of the CPI, which has been published by the Bureau of Labor Statistics for decades. In contrast, deriving the PLCSI relies on the analytical tools of the economist, which may appear to the non-economist as a bit of a black box. Yet economists have used the cost model for decades to analyze production and costs in many industries, including library services (e.g., see Chressanthis 1995 and DeBoer 1992).

[1] See, for example, Mansfield (1975), pp. 118–232.

Another major difference between the two indexes is that the PLICI represents essentially a weighted average of the series of public library input prices, while the PLCSI places emphasis on the cost of producing library services. As such, the PLCSI attempts to account for the patterns of variation in changes (e.g., improvements) in the level of library services, as well as differences in geographic location. By focusing on the types and levels of library service, the inflation rates produced by the PLCSI reflect input substitutions in response to relative price changes or changes in technology over time, which affect the way library inputs are combined to produce services. The inflation rates produced by the PLICI do not account for these factors.

It is worth noting that the PLCSI, by controlling for various types and levels of services in the way that it does, addresses at least some of the problems that economists have contended create bias in the CPI and other fixed-basket price indexes. A recent paper by Moulton (1996) addresses some of these problems with regard to the construction of the CPI.

A Comparison of Public Library Inflation Rates Using Each Approach

During the period from 1989–90 to 1992–93, the PLICI created by the AIR (PLICIa) shows an average annual rate of inflation of 4.3 percent in the prices of library inputs. In marked contrast, the cost-based PLCSI exhibits an average annual inflation rate of 3.9 percent during that same period. For comparison purposes, household consumer prices rose at an average annual rate of 3.9 percent, while producer prices rose at 2.4 percent over this same period.[2]

The PLICIa estimates of annual inflation rates based upon the FMB approach show roughly similar patterns of decline from 1989–90 to 1992–93 as annual inflation rates based upon the CPI. This is not surprising since several components of the CPI were used to calculate the input cost index of various library expenditure categories using the FMB approach. For example, the input cost index of the major library expenditure category, books and periodicals, is based upon the CPI data.

Inflation rates derived from the cost of services model show lower rates of inflation than those derived using the FMB approach. This is consistent with the expectation that the cost of services model should control better for increases in the costs of library services due to improvements in the level of services or technological change.[3]

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[2] Bureau of Labor Statistics, Consumer Price Index, Washington, DC: U.S. Department of Labor, data years 1989–1993 and Bureau of Labor Statistics, Producer Price Index, Washington, DC: U.S. Department of Labor, data years 1989–1993. The CPI is a weighted average of a series of price indexes corresponding to the goods and services purchased by the typical urban household. The PPI includes a series of the goods and services typical purchased by producers involved in the production of final goods and services for consumers.

[3] For example, as in the rest of the economy, the demand for skilled workers might have increased relative to unskilled workers. Therefore, total employment of library personnel might have fallen, but those who remain might command higher salaries. These remaining librarians might have the necessary skills (e.g., computer skills) that are required to run a modern library. The fixed-market-basket approach would not adjust for the increase in the skill level of librarians, and increases in library salaries might in part result from higher quality library personnel. This would upwardly bias the fixed-market-basket measure of inflation for libraries.

Implications for Further Research

This report provides suggestions about further data collection and research that would be useful in exploring alternative ways of developing a public library input cost index. The kinds of econometric models used in the development of the PLCSI have the potential to address the factors underlying differences in available library services. This can be accomplished by examining the systematic relationship between library outcomes or services in local communities in relation to variations in local community characteristics (e.g., income and education levels of the local community) and the federal and state grants on library spending and service levels.

Chapter 1. Introduction

Indexes of inflation, particularly the Consumer Price Index, or CPI, have become important budgeting tools in the past decade. Lowered revenues and fiscal conservatism have created pressures to restrain the real growth of government expenditures. The CPI is currently used as a tool for determining how much expenditures should increase to maintain the same level of services. Inflation indicators, particularly the CPI, must be used with some care. The CPI is a measure of prices of goods and services purchased by a typical household during a base time period: automobiles, family housing, appliances, medical services, food, and the hundreds of other items that make up a household budget. The CPI considers only those goods and services that are used by the typical household to feed, clothe, and maintain a constant standard of living.

But typically, the budgets of libraries and other public agencies do not include household goods and services. Public libraries employ the necessary combinations of personnel and non-personnel inputs in order to provide library services. Thus, while the CPI reflects the rising prices of household consumer goods and services, a public library cost (of inputs) index reflects the rising costs of personnel and non-personnel inputs purchased by these libraries.

In an age of tight federal, state, and local government budgets, it is essential for officials in public agencies to have full and accurate information about the cost of providing public services. Public libraries[4] utilize a wide range of personnel and non-personnel inputs, and like many other public agencies, need to understand their costs of operation and need to justify requests for increases in funding. Over time, increases in the costs of inputs result, at least in part, from inflationary pressures that affect the economy in general. Therefore, to allow meaningful comparisons of library revenue and expenditures over time, it is important to adjust reported dollars by an appropriate inflation index.[5] This need for an accurate

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[4] For the purposes of this report, a public library is defined in a manner consistent with the definition in the NCES E.D. TABS report (NCES 95-129) of September 1995, Public Libraries in the United States: 1993. The definition in appendix B of this report reads as follows:

> *A public library is established under state enabling laws and regulations to serve the residents of a community, district, or region. A public library is an entity that provides at least the following: 1) an organized collection of printed or other library materials, or a combination thereof, 2) a paid staff to provide and interpret such materials as required to meet the informational, cultural, recreational, and/or educational needs of a clientele, 3) an established schedule in which services of the personnel are available to clientele, and 4) the facilities necessary to support such a collection, personnel, and schedule*

It should also be noted that this report is focused entirely on public libraries. Whenever the word "library" is used in this report, it refers to a public library. While elements of this analysis might well be applied to other kinds of library institutions (e.g., academic libraries), the references to libraries in this report should be interpreted exclusively as public libraries.

[5] Inflation is defined as an increase in the overall cost of living or of production of a set of services (see, for example, Fisher and Shell 1972). It occurs when the average prices of goods and services used by consumers or producers are rising. It is

assessment of the fiscal status of libraries requires a specifically designed inflation measure for public libraries. Such an index would provide valuable insights about the increasing prices of inputs faced by public libraries. Until now, the CPI has commonly been used to deflate expenditure data for public agencies. But the CPI is not the most appropriate measure for use in indexing library revenues and expenditures because it focuses on the prices of household consumer goods and services such as food and shelter rather than the prices of library inputs.

One source of information on public library expenditures and revenues is the Public Libraries Survey, conducted annually by the National Center for Education Statistics (NCES). This survey utilizes data collected from each state through the Federal-State Cooperative Systems (FSCS). However, because these data are not indexed for inflation, the true impact of inflation on public libraries cannot be assessed. For example, one cannot determine whether the increases in total library revenue that have been shown by FSCS data in recent years led to increases in services or were consumed by inflation.

Purpose of This Report

The purpose of this report is to present and evaluate alternative approaches to the development of an index of inflation for public libraries. The first of these alternatives uses a methodology similar to that employed in the development of the standard CPI. The standard CPI is essentially an index of the differences in the prices of consumer goods and services between two points in time, weighted by a fixed-market-basket (FMB) of household goods and services. The public library input cost index (PLICI) developed in this report is an index of the differences in the costs of library inputs between two points in time, weighted by a FMB of library inputs. This report examines two FMB public library input cost indexes (subsequently referred to simply as the PLICI): one developed specifically for the purposes of this report by the staff of the American Institutes for Research (AIR), subsequently referred to as PLICIa; and one that was published in 1995 (Halstead 1995), subsequently referred to as PLICIb.[9]

In addition to the FMB approach, an alternative approach to measuring inflation is based on a model of public library services costs similar to models used by economists to analyze the costs of production in any goods or service industry. This methodology uses econometric techniques to control for differences in the level of public library services such as library visits, circulation, and reference transactions, as well as the distribution of geographic cost differences, in order to isolate the changes in the costs of these services over time. This approach will subsequently be referred to as the public library cost of services model, and the index will be referred to as the public library cost of services index (PLCSI). While the PLICI represents essentially a weighted average of the series of public library input costs, the PLCSI places emphasis on the cost of producing library services (or outputs). Since library services can be produced with more than one specific combination of library inputs, the PLICI is not a *true* cost index because it does not necessarily hold library services constant. The PLCSI represents an attempt to account

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possible to measure inflation using information on changes in prices of goods and services used by consumers or the wages and prices paid by producers for the inputs used for production or service provision. These wage and price data are combined with information on the relative importance of these goods, services, or inputs in the overall budgets of households or agencies. A standard cost index, like the CPI, uses this information to create a weighted average of price changes that assigns greater relative importance to goods and services that typically consume a greater proportion of the household or agency budget.

[9] In the original report by Halstead (1995), he refers to his measure of inflation for public libraries as the PLPI or Public Library Price Index. The PLPI has been renamed in the present report and is referred to as the PLICI or Public Library Input Cost Index. This follows the standard established by the Bureau of Labor Statistics (BLS) to refer to indexes of the prices of outputs as *price indexes* and those based on input costs as *cost indexes*. Thus, the PLICIb is the same as what Halstead refers to as the PLPI in his report. The Consumer Price Index (CPI) is actually a cost index according to the BLS definition, but the word "Price" was retained in the CPI for historical reasons.

for these substitution possibilities among various library inputs by controlling for the level of library services or outputs. This trade-off among library inputs is discussed in more detail in chapter 2.

This report presents the estimates of inflation rates derived from the FMB and PLCSI approaches, and it compares these approaches in terms of their advantages and disadvantages. Data requirements for FMB versus the PLCSI analysis and the quality of the data used in calculating each differ significantly. Moreover, each approach involves certain assumptions about the way public libraries operate, and each contains limitations in the way the cost and price data may be interpreted. This report also provides suggestions about further data collection and research that could be used to explore alternative ways of developing a public library input cost index.

Chapter 2 describes the PLICI and the PLCSI approaches in some detail. Chapter 3 offers an empirical analysis of the PLICI, including an analysis of budget shares and input cost series. Chapter 4 presents the PLCSI. Chapter 5 (the conclusion) compares the inflation index derived from the PLCSI with that from the PLICI and suggests ways of improving the public library indexes.

Terminology

In order to add clarity to the presentation, it is useful to define a few economic and statistical terms used throughout this report. These terms are listed and defined in the glossary of terms, beginning on page 53 of this report.

Chapter 2. Conceptual Framework

There are two basic methodological approaches to developing an inflationary index for public libraries: one is generally referred to as the fixed-market-basket (FMB) approach, and the other is based on the development of a cost of services model. This chapter describes these two approaches and how they are used in this report.

Fixed-Market-Basket Approach

Briefly, the FMB index approach makes the assumption that a public library purchases the same inputs—e.g., library personnel, books, and magazines—over time to produce public library services such as circulation of library materials and responding to reference requests. It makes use of data about the prices and quantities of these inputs. Table 1 illustrates how an FMB index may be constructed for a public library. In this simple example, it is assumed that there are only two inputs utilized by this library: namely, librarians and books. Obviously, a real public library uses many additional inputs to produce library services, and the PLICI produced later in this report (PLICIa) will reflect these other inputs. However, for the purposes of illustration, this simple two-input model of a public library may be used to demonstrate several problems that arise in the construction of price indexes. One problem is that the combinations of inputs (i.e., the market basket) used to produce a given level of services or outputs is not fixed. Also, the estimated rate of inflation will depend upon which year is chosen as a base for purposes of calculating the index.

Table 1 shows the budget or expenditures[7] of a two-input library under alternative assumptions for two different years, 1 and 2, designated in column 1. Columns 2 through 5 represent the prices (W, P) and quantities (L, Q) of the two inputs—librarians and books, respectively—purchased by this public library during each of the two years. The first six columns are relatively self-explanatory. In year 1, the library paid annual wages amounting to $30,000 per full-time-equivalent (FTE) librarian and employed 2.00 FTEs. In addition, this library paid an average price of $40 per book and added 500 books to its collection. In year 2, the annual wage of an FTE librarian increased from $30,000 to $31,000, and the library employed 2.40

[7] For the purposes of simplification, economists often use the terms "budget" and "expenditure" interchangeably (see, for example, Mansfield 1975). Although these terms do not technically have the same meaning (e.g., annual expenditures may be less than the annual budget allocation), economists generally assume that expenditures roughly equal the budget allocation for a given year. It is also assumed that library income is roughly equal to their expenditures or spending for a particular year. All of these assumptions approximately hold provided that public libraries do not accumulate large portions of debt or savings from one year to the next. Consequently, the effect on the analysis of the use of the term "budget" versus "expenditures," or "income" versus "expenditures," is negligible.

Table 1.— Hypothetical example of fixed-market-basket (FMB) public library input cost index

Year	Average Annual wage of librarians	Input: FTE librarians employed	Average price per book	Input: quantity of books purchased	Total budget	Simulated budgets: For purchasing year 1 inputs	Simulated budgets: For purchasing year 2 inputs	Alternative PLICI: FMB: year 1 inputs	Alternative PLICI: FMB: year 2 inputs
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(W)	(L)	(P)	(Q)	(B)				
1	$30,000	2.00	$40	500	$80,000	$80,000	$93,000	100.00	96.42
2	31,000	2.40	42	525	96,450	83,000	96,450	103.75	100.00
					% increase: 20.56	Estimation of inflation:		3.75%	3.71%

librarians. Book prices increased from $40 to $42 per book, and 525 books were added to the collection. The total in column 6 is the actual budget of the library, which increased from $80,000 to $96,450, an increase of over 20 percent, from year 1 to year 2. But how much of this increase in the budget was due to inflation in the prices of library inputs, and how much was due to increases in the quantities of library inputs purchased?

Columns 7 and 8 simulate the budget for this sample library for each of the two years under alternative assumptions about the market basket of library inputs purchased. Column 7 simulates what the library budget would have been in each year if it had purchased the same quantities of library inputs as it did in year 1. Column 8 simulates what the library budget would have been in each year if it had purchased the same quantities of library inputs as it did in year 2.

Comparison of these simulated budgets using the FMB of inputs permits one to develop estimates of price inflation between the two years, since the only differences between the two budgets presented in each column are the differences in prices of the inputs. For example, using the year 1 purchases of inputs as the base, one defines the PLICI to be 100.00 in year 1 (the base year), and computes an index of 103.75 (the ratio of 83,000 to 80,000) in year 2. Since the quantities of inputs are fixed, the only difference between these two simulated budgets are in the prices paid for the inputs. An estimate of inflation between the two years using year 1 as the base is calculated as follows:

$$\text{Estimate of price inflation} = (83{,}000 - 80{,}000)/80{,}000$$
$$= 3.75 \text{ percent}$$

An index of inflation using the earliest year for which data are available as the base is commonly referred to by economists as a Laspeyres index. The Laspeyres index is the one most commonly used for the development of price indexes and is currently the methodology used by the Bureau of Labor Statistics (BLS) for the calculation of the CPI.

However, it is interesting to note that if one uses the year 2 purchases of inputs as the base, one can calculate a PLICI of 96.42 in year 1 and an index of 100.00 in year 2 (the base year). Once again, since the quantities of inputs are fixed, the only difference between these two simulated budgets is in the prices paid for the inputs. An estimate of inflation between the two years using year 2 inputs is calculated as follows:

Estimate of price inflation = (96,450 – 93,000)/93,000
= 3.71 percent

In both cases, the ratio is the difference, divided by the year 1 budget. An index of inflation using the later year's inputs as the base is commonly referred to by economists as a Paasche index.

Both of these indexes represent FMB public library input cost indexes. Each essentially represents a weighted average of the price inflation for the two library inputs where the weights are the quantities of inputs purchased. These weights simply measure the importance of each input in the overall budget for library services. It is no surprise that the two indexes result in different estimates of inflation because each uses a different set of weights. The Laspeyres index, which uses year 1 budget shares, in this instance provides a higher estimate of inflation (3.75 percent) than the Paasche index (3.71 percent), which uses year 2 budget shares.

It should also be noted that the FMB approach assumes that the quality of library inputs does not change from one year to the next. It assumes that price increases do not reflect the availability of "new and improved" products. In practice, though, the FMB approach is unable to completely control for changes in quality. However, this bias can be lessened by occasionally modifying the base year budget shares of inputs. The Bureau of Labor Statistics (BLS), for example, modifies the base year budget shares of the CPI about every 10 years.

Because data are simply not available on all of the detailed quantities and prices of the individual items actually purchased by libraries, it is necessary to use an alternative expression to define a FMB-PLICI. That is, data on the quantities and prices of printed media, nonprint media, access (or on-line computer) services, and even different categories of personnel (head librarians, librarians, clerks) are not available in the simple form expressed in table 1. The data that are available are generally expressed in the form of shares of library expenditures allocated to different categories of inputs and different indexes from various sources on the changes in the prices paid for individual inputs. The FMB-PLICI indexes presented above can be expressed in the following form:

$$\text{FMB-PLICI} = LWI_t \times LSHARE_0 + BPI_t \times BSHARE_0$$

where

LWI_t = the librarian wage index in year t (the ratio of wage rates in year t to wage rates in year 0);

$LSHARE_0$ = the proportion of library budgets allocated to librarians' wages in the base year (i.e., the budget share for librarians);

BPI_t = an input cost index for books in year t (the ratio of book prices in year t to book-prices in year 0);

$BSHARE_0$ = the proportion of library budgets allocated to books in the base year (i.e., the budget share for books).

Using the data from table 1, one can calculate the Laspeyres index as follows:

LWI_t = 100 × \$31,000/\$30,000 = 103.33
$LSHARE_0$ = \$30,000 × 2.00/\$80,000 = .75
BPI_t = 100 × \$42/\$40 = 105.00
$BSHARE_0$ = \$40 × 500/\$80,000 = .25

Laspeyres index = 103.33 × .75 + 105.00 × .25 = 103.75

The Laspeyres index is the one most commonly used for the development of price indexes and is currently the methodology used by the BLS for the calculation of the CPI. Moreover, a Laspeyres index has been developed by the Research Associates of Washington (Halstead 1995) to measure inflation faced by public libraries.

It should be noted, however, that an FMB index could be, in a sense, a combination of both a Laspeyres and a Paasche index. Suppose, for instance, that the above example is extended to three time periods (year 1, year 2, and year 3) and year 2 is chosen as the base year. Consequently, the index from year 1 to year 2 would be a Paasche index, while the index from year 2 to year 3 would be a Laspeyres index. If the year 2 base year were maintained as additional yearly data were added to the index (years 4, 5, 6, etc.), the index from year 2 to a future year would be a Laspeyres index. As shown later in the report, the PLICI created by AIR is a combination of a Paasche and a Laspeyres index.

A Public Library Cost of Services Model

A major problem with the FMB approach to deriving an inflation index (i.e., the Laspeyres or Paasche indexes) is that it does not really reflect what a *true* cost index is supposed to represent. To be specific, economists define a consumer price index in the following terms:

> *A consumer price index is supposed to reflect the relative difference in consumer spending (of income) required to achieve* ***a constant level of satisfaction*** *between any two time periods.*[5]

The key phrase, "*a constant level of satisfaction,*" is what distinguishes a true cost index from an FMB index. The consumer price index should reflect the change in income required to make the consumer feel as well off in year 2 as in year 1 given the changes in the prices of the consumer goods and services that occurred during that period. To be clear, what is required in this context is a way of controlling for changes in the level of satisfaction from one point in time to another in order to determine how much of the change in spending is associated purely with changes in the prices of items included in the market basket.

What causes the difference between an FMB and a *true* cost index is the willingness of the consumer to trade off one good against another when confronting different relative prices of the two goods. For example, suppose the price of both coffee and tea increase over time, but the price of coffee increases relatively more than the price of tea. As the cost of coffee increases relative to tea, one would expect consumers to use tea as a substitute for coffee. That is, to maintain the consumer's level of satisfaction would not require sufficient additional income to purchase the same quantities of coffee and

[5] For a detailed discussion regarding the definition of a consumer price index, see Fisher and Shell (1972).

tea as in the base period. Rather, as the relative cost of coffee increases, the additional spending (or income) required to maintain a constant level of satisfaction for the consumer would be less than that required to purchase the same quantities of coffee and tea as in the base period, as the consumer uses tea, which is relatively less expensive, as a substitute for coffee.[9]

Applying the same reasoning to library inputs, the economist would define a *true* cost index for library services as follows:

> *A public library cost of services index (PLCSI) should reflect the relative difference in library budgets necessary to achieve a constant level of library services (or outputs) between any two time periods.*

Library services are produced through various combinations of library inputs such as library directors, non-supervisory professional personnel, printed media, nonprint media, access (or on-line computer) services, furnishings and equipment, and building space. As the costs of library personnel increase over time, there may be changes in the relative costs of these categories of personnel that would cause changes in the allocation of library budgets among the different types of personnel.

The economist postulates a systematic relationship between the level of library services (outputs) and the library inputs. The term output as applied to libraries is a general term referring to several types of services offered by libraries, such as circulation transactions and reference services. Moreover, there are many possible trade-offs among various library inputs that would result in similar levels of library outputs. For the purpose of this analysis, it is assumed that library decisionmakers are attempting to maximize the level of library services within the library budget allocated by the appropriate local government entity. This decisionmaking process results in certain systematic patterns of allocating resources to library inputs, given the budget and the relative prices of the inputs. The result of this process is a systematic relationship between the total expenditures on library services, the level of services provided, and the relative prices of the necessary library inputs used. This relationship might be expressed in the following general form:

Equation (1) $E = C(S,P)$

where

E = expenditures on library services
S = various levels of library outputs (e.g., circulation transactions, reference transactions, library visits)
P = a set of prices of library inputs (e.g., library personnel or books)

and C(S,P) is defined as the cost function that relates expenditures to the level of library services (S) and the prices (P) of library inputs.[10] In a more sophisticated version of this cost function, libraries in various

[9] None of this discussion is intended to suggest that the consumer is indifferent between drinking coffee or tea. It suggests that at some relative price, consumers will trade one for the other in order to maintain overall *satisfaction* levels.

[10] For a more formal, mathematical presentation of the derivation of a cost function, the reader should refer to Mansfield (1975), pp. 118–232. The word "function" is a mathematical expression that relates certain independent or explanatory variables such as the service levels and input prices (S and P, in the example in the text) to a dependent variable such as expenditures (E in the example in the text).

geographic locations can be analyzed separately in order to create a geographic cost index. Another variation on the above cost function is to separately analyze libraries serving various population sizes.[11]

The advantage of applying this type of cost function approach to the development of a cost of services index for library services is that it allows the analyst to take the level of services provided into account, rather than simply the level of inputs. The relationship captures the impact on expenditures and costs of input substitutions that may result from changes in the relative prices of inputs.

So why use the FMB approach at all? In the analysis of consumer prices, the primary reason economists resort to the FMB approach is that there are no simple or straightforward ways of assessing consumer satisfaction; the FMB approach provides a simple, understandable approximation of the true index.

However, the FMB approach assumes that the combination of library inputs is not affected by technological change. In other words, the approach assumes that improvements in the quality or character of the inputs (e.g., the advent of computer hardware or software that increases the level of services available to clients) do not result in changes in the combination of inputs. Moreover, the FMB approach assumes that there are no changes in the combination of inputs resulting from changes over time in the scale of operation (e.g., growth of a library that permits use of different technologies for producing services).

Given that the FMB approach assumes a constant combination of library inputs over time, it can be shown that, under the usual assumptions of increasing prices, the Laspeyres index generally overstates the true rate of inflation, while the Paasche index understates the true rate of inflation.[12] This holds because those who purchase goods and services tend to seek out less expensive alternatives.

Although measures of consumer satisfaction are difficult to obtain, a variety of measures of library services or outputs are available. These measures allow the analyst to explore the systematic patterns of variation in library expenditures in relation to service levels and the costs of individual library inputs. Using econometric methods, one can develop a public library cost of services index (PLCSI) based on the public library cost of services model (see equation 1). This index can be used to develop an inflationary index, but can also be used to geographically compare costs faced by libraries at a point in time.

Economists have generally made use of such cost of services indexes in the context of the private sector (e.g., Griliches 1961) and have also used this methodology to analyze the costs of library services (e.g., see Chressanthis 1995; DeBoer 1992). However, when the cost of services model approach is applied to the private sector, economists are assuming that competition in private markets will drive competitive firms to achieve efficiency in the organization of production and the allocation of resources. Firms that do not achieve efficiency simply do not survive, and optimizing behavior is an important assumption underlying the estimation of a cost function.

This raises some concern in application of the cost function approach in the public sector. Are public libraries operating in an environment that drives them to operate efficiently? Restrictive budgets in the public sector and the effort by government decisionmakers to reflect community preferences are assumed in this context to replace the pressures of the private market. But there is a considerable literature

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[11] The word "population" as used in the text generally refers to what the FSCS database calls the "population of the legal service area" for the library.

[12] For an illustration of this bias in the Laspeyres and Paasche indexes, see Fisher and Shell (1972), pp. 57–58.

in economics which questions the incentives for efficient operations in the public sector (e.g., Niskanen 1971, Alchian 1971). Thus, if one can legitimately question the incentives for efficient operation of public libraries, it is unclear whether estimation of a public library cost function reflects a true cost relationship between expenditures, outputs, and prices.

The differences between the cost approach and the FMB approach are summarized below:

Table 2.— Comparison of fixed-market-basket (FMB) approach and cost of services model approach

	Fixed-Market-Basket (FMB) Approach	Cost of Services Model Approach
Basic Assumptions	The FMB assumes that libraries purchase the same inputs over time. It also assumes that the quality of inputs does not change from one year to the next. No assumption of community preferences is necessary.	The assumption of a fixed market basket is not necessary. The cost of services model allows for changes in the composition and quality of inputs resulting from changes in the relative price of inputs, changes in the scale of operation, and changes in technology. Assumes that the government follows community preferences when supplying public services, and that library officials are motivated to organize and allocate resources efficiently.
Commodity Substitution Bias	Under the usual assumptions of increasing prices, a fixed-market-basket (FMB) index can overstate the true rate of inflation (if the index is a Laspeyres index) or understate the true rate (if the index is a Paasche index). These biases stem from the assumption that libraries purchase the same inputs over time.	Since the assumption of constant inputs is not necessary, such biases are less likely to occur.
Previous Uses of this Approach	The FMB approach has been used to calculate the Consumer Price Index (CPI), and has also been previously used to develop an input cost index for libraries.	The cost of services model has commonly been used in studies of private sector markets, but has also been used to analyze library services. The cost approach has been used to develop an input cost index to measure inflation but also has been used to geographically compare costs faced by libraries during a point in time.
Complexity	The FMB index is an input cost index and is generally easier to understand. For example, many people are familiar with the CPI.	The cost of services model is used to develop an output cost index that relies on econometric modeling. Consequently, it may be difficult to understand on the part of non-economists.
Data Requirements	Requires the collection of data pertaining to several input price series.	Does not rely on such extensive data collection. Consequently, it is cheaper to maintain.
Adjustments for Quality of Personnel	The FMB indexes presented in this report use average salaries of library personnel. These salaries are not corrected for differences in the qualifications or other personal characteristics of library personnel. However, this is not inherent to the FMB approach as salaries adjusted for these characteristics, if available, may also be used in this type of analysis (see Chambers, 1997).	The cost of services model, by focusing on library services or outputs, implicitly takes into account differences in the quality of personnel.

The next chapter contains a more detailed discussion of the data used in the development of both the PLICI and the PLCSI.

Chapter 3. Empirical Analysis of a Public Library Input Cost Index

This chapter describes the data used to derive a public library input cost index (PLICI), based on the fixed-market-basket (FMB) approach. The first section describes the data sources for estimating the typical budget shares applied to each of the library inputs for public libraries. The second section introduces the input cost indexes to be used for each of the categories of inputs including library personnel, books, periodicals, and supplies and materials. Further, the second section evaluates these input cost indexes and tests the impact on the overall index of various input cost indexes that may be used. The final section combines the budget shares with the input cost indexes to develop alternative PLICIs. In addition, different PLICIs are produced for libraries of different sizes.

Comparisons between the PLICIa (developed by the American Institutes for Research) and the PLICIb (developed by the Research Associates of Washington) are also presented in this section. Research Associates of Washington (RAW) developed its version of a PLICI prior to the version developed by the American Institutes for Research (AIR). Consequently, the AIR index builds on the important work done by RAW. RAW and AIR used the same basic methodology to develop a FMB index. However, the most important difference in the methodology used by RAW and AIR is the choice of input cost indexes that are used for the various categories of inputs.

Analysis of Budget Shares

The first step in constructing an FMB index is to determine budget shares. Public libraries purchase a wide variety of inputs. However, it would be difficult and costly to collect data on every item that public libraries purchase. Thus, one of the issues that must be resolved is how to classify library inputs into a number of relatively homogeneous categories for which information on price changes over time can be obtained. Table 3 presents a detailed taxonomy of library inputs similar to the taxonomy published by RAW.[13] The taxonomy published by RAW is based upon a 1991 data year study of New York State public libraries sponsored by the New York State Division of Library Development.[14] The taxonomy represents the percentage of the library budget (sometimes called the budget weight or the budget share) that is devoted to particular expenditure categories.

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[13] See, for example, Halstead, K. (1995). *Inflation Measures for Schools, Colleges, and Libraries: 1995 Update*. Washington, DC: Research Associates of Washington. Used by permission.

[14] See New York State Library. (1992). *1992 Public and Association Libraries Statistics*. Albany, NY: New York State Library, Division of Library Development. The data year pertaining to this study is 1991.

Unfortunately, there is no national data source available with all of the elements necessary to construct budget shares. The budget shares created for the development of the PLICIa have been constructed from a variety of sources including the New York State Library study (data year 1991) and the Federal State Cooperative System (FSCS) data set maintained by National Center for Educational Statistics (NCES), as reported by public libraries (data year FY1991). FSCS data covering fiscal year 1991 were selected for use because the year of the FSCS data collection approximately matches the year of data collection used in the New York State study. Consequently, the base year of the PLICIa (AIR index) is not set at the time period corresponding to the beginning of the input cost index or to the end of the input cost index. As mentioned previously, this makes the resulting PLICIa index presented in this report a kind of mixture of a Laspeyres and a Paasche index. On the other hand, the PLICI created by RAW (PLICIb) is a Laspeyres index. As a result, the FSCS data year used by RAW does not correspond to the data year used in the New York State study. It should be noted, though, that over short periods of time, the budget shares derived from the FSCS data do not substantially change. Thus, the choice of a base year for these analyses is not likely to have much impact on the estimates of inflation.[15]

Following the approach used by RAW, FSCS data are used to estimate the budget shares for the broad categories of library inputs (i.e., personnel compensation, acquisitions, and other operating expenditures), making use of the following FSCS variables: salary and wages expenditures, collection expenditures, and other operating expenditures. Unfortunately, the FSCS data set does not provide detailed information on budget shares. As a result, the New York State study data are used to estimate budget shares for the categories of inputs within the broad categories. The approach of using FSCS data to estimate broad-category budget shares and the New York State study data to estimate budget shares within broad categories follows that used by RAW. Unfortunately, the FSCS definition of operating expenditures include some capital outlays, such as expenditures on replacement and repair of existing furnishings and equipment (including computers). In addition, local accounting practices can be used to determine whether an item is a capital outlay or an operating expenditure. This leads to difficulties in evaluating the extent to which capital outlays are included in the FSCS operating expenditures category.

Although representative of New York State, the New York State Library study (data year FY 1991) does not necessarily represent the size distribution of public libraries in other parts of the country; New York State on average has larger-sized libraries compared with the rest of the nation.[16] The question raised by this is whether smaller versus larger libraries have systematically different allocations of expenditures among library inputs. That is, are there any effects of library size on the budget shares?

The data on budget shares presented in table 3 combine information from the New York State Library study with information obtained from analysis of the NCES Public Libraries Survey data. The budget shares for the broader categories of public library inputs (personnel compensation, acquisitions, and other operating expenditures) are derived from NCES data, while the breakdowns of these into finer categories are based on data published by RAW and derived from the New York State Library study sponsored the New York State Division of Library Development. AIR separates libraries into size categories: small (serving a population of less than 25,000), medium (serving a population between 25,000 and 99,999), large

[15] Preliminary analysis conducted by AIR showed that changes in the FSCS base year did not substantially change the value of the overall index, despite the fact that the advisory committee indicated potential data quality problems in the use of the FSCS 1989 and 1990 data.

[16] See New York State Library (1992).

Table 3.— Budget shares[1] (in percentages) allocated to public library inputs by small-, medium-, and large-sized libraries,[2] 1991

Type of Operating Expenditure	Small-sized Libraries	Medium-sized Libraries	Large-sized Libraries	Medium- or Large-sized Libraries
Personnel Compensation				
Salaries and Wages				
Library directors	19.8%	22.9%	22.8%	22.9%
Other managerial staff	2.7	3.1	3.1	3.1
Non-supervisory professional staff	19.3	22.4	22.3	22.4
Support staff	3.1	3.6	3.6	3.6
Fringe Benefits	10.0	11.6	11.6	11.6
Total Personnel Compensation	55.0	63.6	63.5	63.6
(standard error)[3]	(0.60)	(1.31)	(2.28)	(1.13)
Acquisitions				
Printed Media				
Books and periodicals	15.7	11.4	11.0	11.3
Other serials (e.g., newspapers)	0.3	0.2	0.2	0.2
Other printed materials	0.4	0.3	0.3	0.3
Nonprint Media				
Microforms	1.0	0.7	0.7	0.7
Audio recordings	0.8	0.6	0.6	0.6
Video	2.8	2.0	1.9	2.0
CD-ROM	0.1	0.1	0.1	0.1
Graphic images	0.1	0.1	0.1	0.1
Access (or on-line computer) Services	0.3	0.2	0.2	0.2
Total Acquisitions	21.6	15.8	15.1	15.8
(standard error)	(0.49)	(0.99)	(1.69)	(0.86)
Other Operating Expenditures				
Office Operations				
Office expenditures	1.3	1.1	1.2	1.1
Supplies and materials	5.1	4.5	4.6	4.5
Non-capital Equipment	0.2	0.2	0.2	0.2
Utilities	8.0	7.0	7.3	7.1
Contracted Services	8.9	7.8	8.1	7.9
Total Other Operating Expenditures	23.4	20.6	21.4	20.6
(standard error)	(0.51)	(1.10)	(1.94)	(0.95)
Total	100.0%	100.0%	100.0%	100.0%

[1] Budget percentages for totals of broad categories (personnel compensation, acquisitions, other operating expenditures) from U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Year FY1991. Budget percentages within broad categories and budget taxonomy from Halstead, K. (1995). *Inflation measures for schools, colleges, and libraries: 1995 update*. Washington, DC: Research Associates of Washington. Budget percentages may not sum to 100 percent due to rounding.
[2] Small-sized, medium-sized, and large-sized libraries serve a legal service area of less than 25,000; 25,000–99,999; and 100,000+ persons, respectively.
[3] Standard errors of budget percentages for broad categories are in parentheses. Standard errors of budget percentages within broad categories could not be derived since raw data were not available.

(serving a population of 100,000+), and medium or large (serving populations of 25,000+).[17] These size categories are consistent with those used by the American Library Association (ALA) in their annual survey of librarian salaries. As mentioned below, the budget shares corresponding to the smallest size category should be used cautiously. RAW also conducts separate analyses for medium-sized and large-sized libraries, but not for smaller libraries. RAW and AIR define medium- and large-sized libraries in the same way.

[17] The population referred to in this analysis is the "population of the legal service area" of the public library as defined in the Public Libraries Survey.

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Table 4.— Percentage of public libraries in the U.S. and percentage distribution of service area population in the U.S., by population of legal service area, fiscal year 1993

	Population of the legal service area			
	Small-sized (less than 25,000)	Medium-sized (25,000-99,999)	Large-sized (100,000+)	Medium- or Large-sized (25,000-100,000)
Percentage distribution of public libraries	79.4	15.4	5.2	20.6
Percentage distribution of service area population	17.2	25.2	57.6	82.8

SOURCE: U.S. Department of Education, National Center for Education Statistics, Federal State Cooperative System for Public Library Data, Public Library Survey, Data Year FY1993.

It should be noted that it is unclear which library size one would consider "typical." Table 4 shows that over 79 percent of public libraries in the U.S. served populations of less than 25,000 during fiscal year 1993. However, most of the U.S. population during fiscal year 1993 were served by larger libraries. For example, libraries with populations of legal service area of 25,000 or more (about 21 percent of libraries) served over 80 percent of the U.S. population.

Not surprisingly, data presented in table 3 show that public libraries tend to be relatively labor-intensive enterprises. Expenditures on the salaries, wages, and fringe benefits of personnel account for the majority of total operating expenditures (i.e., about 60 percent). In particular, salaries of library directors and non-supervisory professional staff (e.g., those providing reference or cataloging services) account for more than 40 percent of total operating expenditures. Acquisitions make up about 15 percent of total operating expenditures, with book and periodical acquisitions the largest category (about 10 percent of total operating expenditures). Last, other operating expenditures account for over 20 percent of total operating expenditures. For example, utilities and contracted services each make up approximately 7 percent of total operating expenditures. It is interesting to note that the budget shares pertaining to the broad expenditure categories (derived from FSCS data year FY1991) are similar to those found by Fortenbaugh (October 1996) in a study of New Jersey public libraries (data year 1995).

Table 3 shows that small libraries (serving a population of less than 25,000) spend less of their operating expenditures on personnel compensation, and more on acquisitions, compared with larger libraries. It should be pointed out, though, that the broad budget percentages for small libraries, while different from those of larger libraries,[18] are nevertheless reasonably close. However, the budget percentages of the detailed operating expenditure categories for small libraries shown in table 3 should be used with caution because the detailed allocation data were derived from the 1991 data year New York State Library study. We were unable to find a taxonomy of operating expenditure budget shares designed for smaller libraries. For small-sized libraries (population of legal service area of less than 25,000), as well as for large libraries, the budget percentages within broad categories and the budget taxonomy are based on Halstead (1995), which makes use of the 1991 data year New York State Library study (New York State Library 1992). Moreover, as discussed later, information on librarian salaries—a vital source of data for the library

[18] Comparing small-sized libraries (serving a population below 25,000) against larger libraries, the budget shares of each of the three broad categories are significantly different ($t > 2.60$). Comparing medium-sized libraries (serving a population of 25,000-99,999) against large-sized libraries (serving a population of 100,000+), the budget shares of each of the three broad categories are not significantly different ($t < 0.38$).

index—is derived from ALA's annual survey. The ALA data, however, pertain to libraries serving a population of 25,000 or more. Thus, the salary component of the alternative public library input cost indexes (the PLICIs developed by AIR and RAW) should be used with caution when applied to small libraries. A sensitivity analysis, shown later in the report, will demonstrate that variations in the budget percentages for the broad categories of public library inputs does not greatly alter the estimates of inflation derived from the alternative PLICIs. However, the sensitivity analysis is based on the questionable assumption that the budget percentages within the broad categories are representative of libraries of all sizes.

It should be noted that there are some shortcomings of the New York State Library study, which serves as the basis for the taxonomy and budget shares used in this report and by RAW in the development of their library input cost index. As mentioned above, the study disproportionately represents large libraries. Moreover, there are core elements of public library services that are funded by the state, and these elements vary from state to state. This may have an impact on the percentage of a library's budget that is spent on various inputs.

Capital Outlays and Access Services

This input cost index attempts to exclude cost related to capital outlays, such as new construction, furniture, computers, and large equipment. Expenditures on capital outlays tend to be sporadic, changing greatly from one year to the next. An input cost index does not lend itself to the inclusion of such expenditures. There are sophisticated methods to include such expenditures, such as those used by the Bureau of Labor Statistics (BLS) to incorporate the cost of home ownership into the Consumer Price Index (Gillingham 1983). The methodology attempts to separate the investment aspect of purchases from the consumption aspect by assuming that owners of investment items are able to rent such items back to themselves (an "owner's equivalent rent"). Thus, the cost of implicit services derived from the purchase of investment items is estimated using rental data on the investment items. However, annual data on the rental cost of the types of capital investments purchased by libraries could not be located.

Another reason why capital investment does not lend itself to a fixed-market-basket (FMB) approach pertains to year-to-year changes in quality and technology. The FMB approach assumes that the quality of a particular item does not change from one year to the next. Thus, increases in prices are not the result of "new and improved" products. However, capital investments tend to be greatly affected by changes in quality and technology. For example, it would be difficult to interpret the extent to which price changes in computers reflects quality differences or differences in the prices of products that provide similar levels of service. It should be noted, though, that in theory the public library cost of services model (PLCSM) accounts for the effects of changes in quality and technology by focusing on the cost of services rather than interpreting input prices.

Finally, financing decisions involved in the purchase of capital investments typically differ from decisions surrounding current operations purchases. For example, decisions about financing capital investments typically involve the depreciation of the investment over time, as well as the availability of long-term loans to finance the investment. A library administrator arguing for increases in funding to cover needed capital investments would be better served by using methodologies used in public finance (such as cost-benefit analysis of capital investments) than by using an input cost index.

The taxonomy, however, does include budget expenditures on access (on-line computer) services. As will be mentioned later, price series information corresponding to access services could not be located.

However, since such services account for a relatively small percentage of budget expenditures (less than one percent), the impact of excluding access services from the overall index is small. It should be noted, though, that the budget share of access services has likely increased in recent years, although it is also likely that presently the budget share is still low. For example, Bertot et al. (1996) found that access services nationally accounted for only 4 percent of public library budget expenditures between 1994 and 1996. This value is dubious, however, since about 30 percent of those surveyed indicated that they did not know the amount that their library spends on access services.

Analysis of Cost Indexes for Public Library Inputs

The second step in the development of an input cost index involves construction of a series of indexes corresponding to each of the categories of public library inputs displayed in table 2. This section describes the sources and quality of the various cost indexes used for each of these input categories. Since one of the most important and troublesome series pertains to salaries of library personnel, a significant amount of discussion will be allotted to these data.

In addition, this section also makes use of sensitivity analyses to evaluate the PLICI constructed by AIR (PLICIa). In particular, it investigates the sensitivity of the overall index to changes in the use of various plausible input indexes used to construct the PLICIa. This section also investigates the sensitivity of the overall index to changes in the budget shares assigned to various categories of library inputs.

It should be noted that, ideally, each of the cost series used in the analysis should cover the exact same time period. Unfortunately, some of the data used in the analysis are published as fiscal-year data, while others cover calendar years. Moreover, some of the fiscal-year data do not cover the same time period. For example, public libraries surveyed in the FSCS data do not all conform to the same fiscal-year schedule. Further, the issue regarding fiscal versus calendar year data is similar to a general problem pertaining to the inconsistent timing of changes in prices. For example, various geographical locations do not experience increases in costs at exactly the same time, although the Consumer Price Index (CPI) and Producer Price Index (PPI) are not broken down by geographical location.

Personnel Compensation

Personnel compensation makes up approximately 60 percent of public library expenditures. About 80 percent of that goes to salary, the remainder to fringe benefits.

Salary data. Salary data are derived from two sources. For data on salaries of non-support library personnel such as library directors, managerial staff, and non-supervisory professional staff,[19] the ALA data set is used. For salaries of support staff, such as those in custodial or secretarial positions, data are from the Educational Research Services. (See table 8D later in this chapter for source information.)

In fiscal year 1986 and in each year since 1988, the ALA has sent survey questionnaires to over 1,000 randomly selected public and academic libraries on issues pertaining to librarians' current salaries. (Standard errors for tables of analyses are included as appendix C.) In particular, the survey asks for salaries of each employee in various full-time staff positions such as director, deputy/associate director, department/branch head, reference librarian, children/young adult librarian, and cataloger/classifier.

[19] "Non-supervisory professional staff" refers to those who provide reference and cataloging services.

Surveys were collected from medium-sized libraries (those serving a population of between 25,000 and 99,999) and large-sized libraries (those serving a population of 100,000 or more). Thus, a limitation of the ALA data for the purposes of developing an input cost index covering libraries of all sizes is that no small libraries (serving a population of less than 25,000) are included in the sample.

For the purposes of the current analysis, the salary data for the five staff positions used in the ALA survey are collapsed into the three expenditure categories presented in the taxonomy of library inputs in table 3 as follows: library directors includes the two ALA positions of director and deputy/associate director; other managerial staff includes the ALA positions of department/branch head; and non-supervisory professional staff includes the three ALA positions of reference, children/young adult, and cataloger/classifier. As mentioned previously, these expenditure categories are based upon the New York State study of public libraries sponsored by the New York State Division of Library Development.

Two caveats must be kept in mind when using the ALA data set. First, there are significant shifts over time in the percentage of sample observations from medium- to large-sized libraries, and these shifts are more than one would expect from annual employment shifts between these types of libraries. In fact, according to the Public Library Survey data set, among all libraries serving populations of 25,000 or more (the size of libraries sampled by the ALA), 75 percent served populations of 100,000 or more (classified as large-sized libraries in this report) in both data years 1991 and 1992. However, the sample of libraries from which the ALA gathered salary information on directors and deputy/associate directors was not only different from the actual distribution, but also shifted dramatically between 1991 and 1992. The 1991 sample included 40 percent large-sized libraries, while the 1992 sample included 50 percent large-sized libraries. This difference in the distribution of large- and medium-sized libraries raises a concern since large-sized libraries tend to pay higher salaries than medium-sized libraries. Consequently, these shifts in the sample may create a bias in the inflation-index for salaries since the salary data are derived from samples of libraries in different years which exhibit a different composition of large- and medium-sized libraries. For example, shifts in the distribution of libraries from smaller- to larger-sized libraries from one year to the following year may lead to an upward bias in salary inflation. Shifts in the size distribution of libraries have occurred because ALA decided in 1992 to use the FSCS universe file rather than data supplied by a private marketing firm (ALA 1992). Thus, it is likely that this discontinuity actually indicates an improvement in the validity of the ALA salary data.

This problem is partially resolved by separately deriving a salary index for medium- and large-sized libraries, and then deriving a combined index as a weighted average of the two where the budget shares are derived from an alternative source of data (e.g., FSCS data) that more accurately reflects the actual distribution of medium- and large-sized libraries. This technique is used in the development of both PLICIa and PLICIb. However, the combined salary indexes created for the PLICIb (the RAW index) give equal weight to medium- and large-sized libraries, which does not reflect the actual distribution of medium- and large-sized libraries in the universe of public libraries. According to the FY1991 FSCS data, 75 percent of libraries serving populations of 25,000–99,999 are medium-sized, and the remaining 25 percent are classified as large-sized libraries. The PLICIa (i.e., the index produced for this report by AIR) weights the separate salary indexes accordingly in calculating the combined salary index.

To a much lesser extent, there are also regional shifts in the distribution of libraries in the ALA sample, which the PLICIb does not take into account. The PLICIa again uses the FY1991 Public Libraries Survey data set to create regional weights (27 percent from North Atlantic states, 25 percent from Great Lakes and Plains states, 26 percent from Southeastern states, and 22 percent from Western and Southwestern states). The fixed regional and library-size weights used in the PLICIa are similar to weights

Table 5.— ALA data on percentage increase in salaries of library personnel excluding support staff under various assumptions about the distribution of public libraries, by size and region

	Unadjusted Respondent Sample (1)	Weighted to the Same Library Size Distribution Each Year (2)	Weighted to the Same Library Size and Regional Distribution Each Year (3)
1988-89	12.23%	8.28%	6.83%
1989-90	-7.73	8.27	8.23
1990-91	12.27	8.37	6.81
1991-92	-3.64	7.22	8.09
1992-93	0.04	3.16	4.39
1993-94	5.50	4.29	4.33

SOURCE: Salaries and Wages of Professional Library Staff, American Library Association, *ALA Survey of Libraries Salaries. ALA Survey Report*. Chicago and London: American Library Association, 1988–1994 (data years 1988–1994).

used by the BLS in the Employment Cost Index (ECI) to control for year-to-year shifts in the distribution of occupations.

Table 5 shows the percentage increase in library personnel salaries (excluding support staff) derived from the ALA data set under alternative assumptions about the distribution of the sample observations. Salaries of support staff are not shown since they are not derived from the ALA survey. The first column reports the raw figures on salary growth from the ALA sample. When one considers the patterns of inflation in the economy, these figures depict what would appear to be implausibly high year-to-year fluctuations in the growth of library personnel salaries (excluding support staff). The second column adjusts for shifts in the distributions of libraries by size only, but does not adjust for regional differences. Column 2 shows that the adjustment of the ALA salary figures to reflect the actual distribution of libraries by size in the U.S. results in more plausible year-to-year fluctuations in salary growth.

Regional shifts in the ALA public library sample also affect the estimates of salary changes. Column 3 adjusts the salary data derived from the ALA sample to reflect the actual distribution of libraries by both size and region of the U.S. This approach is used in calculation of the PLICIa, but it was not used in the PLICIb. Comparing columns 2 and 3 in table 5, further adjustment of the ALA data for regional differences in the distribution of the sample does have an impact upon the estimated percentage change in library personnel (excluding support staff) salaries. In particular, adjusting for regional shifts (column 3) appears to reduce the salary growth rate during data years 1988 to 1989, 1989 to 1990, and 1990 to 1991. However, adjusting for regional shifts appears to increase the growth rate during data years 1991 to 1992, 1992 to 1993, and 1993 to 1994.

Although the PLICIb does not adjust for regional shifts in the ALA sample data, the impact of failing to make this adjustment upon its index is difficult to assess. In particular, the PLICIb makes use of ALA data only for the library director category, and uses BLS data on the ECI to proxy the salaries of other managerial staff and non-supervisory professional staff. Specifically, for other managerial staff, the PLICIb uses the ECI for local and state government workers categorized by the BLS as executives, administrators, and managers; for non-supervisory professional staff, it uses the ECI for state and local government workers in service occupations.

The use of ECI data by PLICIb to proxy the salaries of other managerial staff and non-supervisory professional staff, however, has some drawbacks. For example, the non-supervisory professional staff category as developed in the PLICIb may include salary information on occupations such as protective services (e.g., police and correctional institution officers), food preparation services, health services, cleaning and building services, and personnel services (e.g., welfare service aides, child care workers). This is particularly troubling since the non-supervisory professional staff category accounts for about 20 percent of library expenditures. Moreover, the PLICIb collapses all of the types of ALA library positions categories into the library director category. These ALA library position categories include: director and deputy/associate directory, department/branch head, reference librarian, children/young adult librarian, and cataloger/classifier. In other words, salary data from such positions as cataloger/classification workers are included in the library directory classification used by RAW in their PLICIb. Salary data from such positions, which seems to be more appropriately placed in the non-supervisory professional staff category, may bias the PLICIb. In short, while the PLICIb de-emphasizes the ALA salary data, it does so at the cost of using potentially inappropriate proxies for the salaries of various library positions.

The salary information used to construct the index of library support staff used in the AIR PLICIa is from the *National Survey of Salaries and Wages in Public Schools* administered by the Educational Research Services. Fiscal year data on salaries of support personnel include information on secretarial/clerical staff and custodial staff.[20] It would be preferable to make use of data on the salary and wages of support staff working in public libraries rather than in schools, but such data are not readily available. As mentioned above, salary information for the professional library staff categories made use of ALA salary data.

A major problem with all of these salary indexes is that none of them are adjusted for differences in the attributes of the workers over time. Changes over time in the composition of the library work force with respect to educational preparation, job experience, or other attributes that may make workers more valuable are currently reflected in all of these salary indexes. That is, a portion of the observed growth in the salaries of non-support library personnel over time might be a result of increases in the average levels of attributes, such as educational preparation and job experience. Since these factors presumably make workers more valuable and more productive over time, they should be excluded from any estimates of inflation in library services. This problem arises from the use of average salaries and represents a problem that affects both the PLICIs presented in this report.[21]

To resolve this issue would require maintaining a database of detailed information on compensation and characteristics of individual public library workers much like the one that has been developed for the *Schools and Staffing Survey* administered by NCES for individual teachers and school librarians. Such a database could be used to develop estimates of salary differences across geographic locations, as well as over time, which would allow the analyst to adjust for differences in the qualifications of library workers and provide a more accurate index of inflationary trends in salary levels. Such data could be collected in connection with the NCES Public Libraries Survey by adding a questionnaire designed to be

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[20]This index is similar to that used by RAW for its Higher Education Cost Index. See Halstead (1995).

[21]While one might argue that although the quality of labor does gradually change over time, quality is held "constant" in the sense that each year one prices current market action (i.e., salary levels) for existing employees. That is, whether it is books or library staff salaries, one is forced to price what is currently available in the marketplace. However, this reasoning ignores the fact that changes in the observed average salaries are to some degree associated with these changes in the composition of any given work force with respect to professional experience and qualifications, both of which presumably impact the quality and efficiency of services received. On the other hand, inflationary pressures result from changes in the supply of labor in a given market, and these pressures will result in an increase in the hourly, and hence annual, rates of pay of individuals with identical qualifications. Thus, to appropriately account for inflation, one must ultimately be able to control for differences in the "quality" of the work force.

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answered by individual public library staff regarding their compensation, personal background, professional qualifications, and working conditions.

In an analysis of inflation in public schools, Chambers (1997) shows that controlling for differences in the characteristics of school personnel over time does result in differences in the measured rate of inflation in the salaries of school personnel. Chambers' paper compares an analysis of inflation in public schools conducted by RAW in the same volume in which the public library input cost index (the PLICIb) is presented. Average salaries of teachers increased by 29 percent over the period from the 1987-88 to the 1993-94 school year. Over this same period of time, Chambers estimated that salary increases, controlling for personal characteristics and qualifications, amounted to 28 percent. Chambers controls for an elaborate set of personal and job assignment characteristics derived from the *Schools and Staffing Survey* administered by NCES.

But even using a more limited set of personal qualifications yields the same results. Chambers compares average salary changes over this same six-year period for a variety of occupational categories used by RAW with changes in salaries adjusted for differences in personal qualifications. Using data from the *Current Population Survey* for management, accounting and technical services, Chambers (1997) estimates average salary changes of 28 percent compared to salary changes adjusted for changes in personal qualifications of 24 percent. For secretaries, clerical and health service personnel, these two estimates are 26 percent and 24 percent, respectively. Thus, controlling for differences in qualifications can have effects on the estimates of inflation.

Another potential source of salary information is the ICMA Municipal Yearbook,[7] which gives information on the salaries of library directors working in small libraries (i.e., serving populations below 25,000) as well as larger libraries. One drawback, however, is that this source of salary information does not publish data separately by library size. Since the salaries of library directors are likely to vary greatly by library size, this data source does not provide as much information as the ALA data set.

Fringe benefits. As an estimate of the change in the cost of fringe benefits, the PLICIa and PLICIb both make use of data from the BLS CPI for medical care. As indicated previously, the CPI, which is used to measure the typical change in prices paid by an urban household, is a Laspeyres FMB index. Increases in the costs paid by consumers on medical care should closely reflect the increasing cost faced by employers of providing health benefits to their employees. Costs are collected in about 85 urban areas and from over 20,000 establishments. In addition to the cost of medical services paid by households, health insurance premiums paid by households are also a component of the CPI medical care category. Unfortunately, the health insurance component is not published separately by the BLS. Benefits paid by employers are assigned to other subcategories within the medical care category. The costs of these health insurance benefits are likely to be closely related to the costs faced by employers of providing health benefits. Moreover, increases in the above medical care CPI should reflect increases in the cost faced by employers providing fringe benefits since increases in the cost of medical benefits probably explains most of the increase in the cost of fringe benefits.

One problem with the use of a separate input cost index for fringe benefits is that such benefits are sometimes dependent upon salary and wage compensation. For example, a library that offers low salaries may nevertheless attract staff by offering an attractive benefits package. In effect, fringe benefits are simply

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[7] For example, International City Management Association (1995), *The Municipal Year Book*, Washington D.C.: International City Management Association.

Table 6.— Overall inflation rates faced by medium- and large-sized libraries combined under two assumptions pertaining to fringe benefits[1]

	Separable Salaries and Benefits	Benefits 22.31 Percent of Salaries
1988-89	4.95%	4.81%
1989-90	6.42	6.42
1990-91	5.44	5.34
1991-92	4.38	4.70
1992-93	3.41	3.28
1993-94	3.55	3.48

[1] Inflation values derived from all of the sources listed in table 8D.

one part of the total compensation package used to attract labor. It is less important to assess changes in the cost of what fringe benefit dollars purchase for employees than to assess the changes in the characteristics of the employees willing to work for the designated total compensation package. Thus, it is difficult to interpret indexes related to salaries and fringe benefits separately. An alternative approach to using an input cost index for items purchased by staff under the name of fringe benefits involves simply using a fixed fringe benefit rate. Table 6 compares library inflation rates derived from the FMB approach using these alternative approaches: one in which an input cost index is used for fringe benefit items and which treats wage and salary compensation separately and one using a fixed fringe benefit rate applied to salaries (i.e., each dollar of salary is associated with 22.31 cents of fringe benefits paid by the employer on behalf of the employee).[2]

As shown in table 6, the two assumptions regarding fringe benefits produce similar results. Since the results do not appear to be sensitive to the alternative assumptions regarding fringe benefits, the PLICIa (AIR index) maintains the same assumption used in the development of the PLICIb (RAW index): salaries and benefits are separable.

Acquisitions

As shown previously in table 3, acquisitions make up about 15 percent of the operating expenditures budget for medium- and large-sized libraries. This category can be separated into three subcategories: printed media (e.g., books, newspapers), nonprint media (e.g., audio recordings, microforms), and access (or on-line computer) services (i.e., through the computer). By far the most important subcategory is printed media, particularly books and periodicals, which account for about 10 percent of public library expenditures.

Printed media. Printed media are composed of books and periodicals, other serials (e.g., newspapers), and other printed materials. One possible data source of book prices to public libraries comes from Baker and Taylor Books, Bridgewater, NJ. However, this unpublished source, which is used in calculating the PLICIb, has been available only since 1992. In theory, one way to assess the reliability of the

[2] This benefit rate of 22.31 percent is derived from table 2 for medium- and large-sized libraries combined. In particular, for libraries serving populations above 25,000, salary expenditures plus 22.31 percent of salary expenditures equal total personnel expenditures.

Table 7.— Percentage change in newspaper costs, using two sources of data

	Consumer Price Index Subcategory: Newspapers	Owens and Swearingen
1990-91	8.84%	4.51%
1991-92	5.67	12.37
1992-93	4.07	3.25
1993-94	4.41	13.91

SOURCE: The Consumer Price Index data are from the Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor (data years 1988-94). The Owens and Swearingen data are from *The Bowker Annual*, New Providence, NJ: Bowker, 1995 (data years 1990-94).

Baker and Taylor price series is to compare this price series over several years with book price series derived from other sources, such as the CPI subcategory of books, magazines, and periodicals. Furthermore, one can be reasonably certain that the CPI price series covering books, magazines, and periodicals will continue for several years. Consequently, the PLICIa, developed by AIR for this report, uses CPI calendar-year data to estimate library expenditures in the books and periodical category.

One possible drawback of using the CPI index is that although these data may represent the types of books typically purchased by households, they may not represent the types of books typically purchased by public libraries. Further, large purchasers of books, such as libraries, may enjoy a discount on book prices, unlike households. However, this would most likely have implications as to the *level* of book prices, but not necessarily on the annual *percentage change* in book prices. This can be demonstrated using a simple hypothetical example. Suppose that the average price of a book purchased by a household is $10.00 in year 1 and $10.50 in year 2. Consequently, households face a 5 percent increase in the price of books between year 1 and year 2. Suppose further that large purchasers of books (e.g., libraries) are offered a 10 percent discount each year on the purchase price of books. The price of a book purchased by libraries would therefore be $9.00 in year 1 (10 percent discount off $10) and $9.45 in year 2 (10 percent discount off $10.50). Again, libraries face a 5 percent increase in book prices between year 1 and 2. Libraries, therefore, face the same percentage increase in the price of books as households. This holds despite the fact that the *level* of book prices differs between libraries and households.

The PLICIa also makes use of the CPI calendar-year index for the subcategory of newspapers to estimate the expenditures of libraries on this type of printed media. As with the CPI cost series on books, magazines, and periodicals, this price series has been developed and calculated by the BLS for several years. The PLICIb uses an alternative cost series on newspapers developed by Owens and Swearingen which reflects the average price of about 170 domestic daily newspapers.[4] However, this again is a relatively new cost index (about 6 years old), and it is unclear whether Owens and Swearingen will continue to collect these data over several calendar years. Table 7 shows the percentage changes in newspaper prices as reflected in the CPI series and the Owens and Swearingen series. As shown in table 7, the percentage change in newspaper cost appears to differ greatly between the two series. This difference may be due to the fact that the sample size (and sampling unit) used in each cost series differs substantially.

[4]See Alexander, A. (1995) Prices of U.S. and foreign published materials. *Bowker Annual, 1995 edition*. New Providence, NJ: R.R. Bowker.

Finally, no available cost series exists for other printed materials, such as manuscripts and documents. Fortunately, this category makes up less than one-half of 1 percent of operating expenditures as shown previously in table 3, and therefore has a negligible impact upon the library inflation index.

Nonprint media. Both the PLICIa and PLICIb indexes make use of cost series covering nonprint media. The quality of proxy data on the costs of nonprint media is dubious. However, since this category makes up only about 3 percent of budget expenditures, the impact upon the total library inflation index is small.[7]

The microfilm cost series was derived from calendar-year data collected by Imre Jarmy of the U.S. Library of Congress. No published documentation of how these data are collected can be found, and therefore their quality is uncertain. Calendar-year data on audio recordings and videos were collected by Dana Alessi of Baker and Taylor and are published in the *Bowker Annual*. These series seem to show very large year-to-year variations in cost, and AIR could not determine why the data show such large variations. Kellogg and Kellogg of the University of Rhode Island and Pamela Mason of the National Agricultural Library have collected calendar-year data on CD-ROM prices, which are also published in the *Bowker Annual*. Again, this series shows what appears to be very large year-to-year variations in cost.

One difficulty in estimating cost changes in the above categories is that the cost may be heavily influenced by technology. It is reasonable to assume that the quality of CD-ROMs has changed significantly in the past 5 years. As mentioned previously, though, the FMB approach assumes that the quality of the goods and services purchased does not change from one year to the next.

A sensitivity analysis of the overall PLICIa indicates that the largest difference in any one year in the library inflation rate derived from the PLICIa, as a result of including or excluding the nonprint media index, occurs between 1988 and 1989.[8] If we were to include the nonprint media index, the overall index would show a 4.95 percent rise between 1988 and 1989, as compared with 5.13 percent if we were to exclude the nonprint media index, a difference of 0.18 percent. This represents a relatively small impact on an inflationary index that ranges from about 3 to 6 percent per year.

Access (or on-line computer) services. Computer access services play an increasingly important role in the operation of libraries, yet they account for typically less than 1 percent of the library budgets, as shown in table 2. Although no price series could be found on this category, its exclusion has little effect upon the total input cost index because of its relatively small percentage of the budget.

Other Operating Expenditures

The FSCS data set includes information on the operating expenditures of libraries, thus one may be tempted take advantage of this information in the development of an input cost series for use in a PLICI. However, the FSCS data do not include the unit prices of operating expenditures (see glossary), nor do they include an input cost index related to operating expenditures. Consequently, the FSCS data on operating expenditures cannot be used to create an input price series in the public library index.

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[7] An input exhibiting a 20 percent increase in price with a 3 percent budget share has an impact of 0.6 percent (=20×0.03) effect on the inflation rate, while an input with the same percentage increase in price and a budget share of 30 percent has a 6.0 percent (=20×0.30) effect on the inflation rate.

[8] Appendix A contains an analysis of the impact of including or excluding the nonprint media price series on the PLICIa.

Most of the published price indexes related to operating expenditures are components of the Producer Price Index (PPI) produced by the BLS.[7] Similar to the CPI, the PPI is a Laspeyres FMB index. The PPI, however, is designed to measure changes in the selling prices received by U.S. producers for their products. In deriving the PPI, BLS collects data from about 500 industries. The indexes used for other operating expenditures in the PLICIa (AIR index) are as follows:

- The input cost indexes pertaining to supplies and materials of public libraries are averaged from the calendar-year PPI index categories of pens, pencils and other office material, and stationery.

- The cost series on noncapital equipment average the calendar-year PPI sub-indexes covering printing trades machines and equipment, indicating/recording electrical equipment, scales and balances, office and store machine equipment, and user terminals and interface equipment.

- The cost series on utilities is averaged from the PPI index categories of natural gas, commercial power, and residual fuels and heating oil.

- Costs of office expenditures are derived from the CPI categories of telephones and postage.

Furthermore, the costs of contracted services make use of two sources. The first is the BLS ECI pertaining to professional, specialty, and technical services. The ECI is a Laspeyres FMB index meant to measure changes in employee compensation (compensation per employee hours worked) for various types of occupations. As mentioned above, the ECI adjusts for year-to-year shifts in the distribution of occupations. The second source is the average weekly earnings of production or non-supervisory workers in the printing and publishing industry, derived from the BLS Employment and Earnings series. Both sources reflect information collected in the calendar year.

Comparison of PLICIa and PLICIb

The approach used in the development of both the PLICIa and PLICIb is the same (i.e., FMB approach), but the choice of input cost indexes used for various components differs. In particular, there are three substantive differences between the PLICIa and the PLICIb pertaining to the use of data sources to develop each index:

- ALA data are used differently to represent salaries of various library personnel positions. Moreover, AIR weights the ALA data by region and library size.

- The PLICIa makes use of data from the CPI subcategory of books, magazines, and periodicals, while PLICIb makes use of data on book prices from Baker and Taylor Books.

- The PLICIa makes use of data from the CPI subcategory of newspapers, while PLICIb makes use of the newspaper price series developed by Owens and Swearingen.

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[7] Many of these indexes are similar to those used by RAW for its Higher Education Cost Index. See Halstead (1995).

The budget shares used to derive the PLICIa (the AIR index) and the PLICIb (the RAW index) are virtually identical, since the same data sources were used to derive the budget shares. There exist very small differences in the budget shares used in the PLICIa and PLICIb. This is primarily due to the fact that the budget shares for items in which no price series could be found by AIR were set to zero. Moreover, unlike the AIR index, in the calculation of budget shares, RAW did not make use of data covering the same year.

Another difference between the PLICIb and the PLICIa is that the PLICIb (RAW) makes use of a Laspeyres index, while the PLICIa (AIR) makes use of a mixed Laspeyres-Paasche index. In other words, the base year of the PLICIb corresponds to the initial time period of the price series, while the base year of the PLICIa falls between the initial and the latest time period of the price series. However, the choice of base year should not produce major differences between the PLICIa and the PLICIb over short time periods such as four or five years.

A more substantial difference in the development of the library input cost index by AIR and RAW, however, is the emphasis by AIR in the evaluation of the index—for example, making use of sensitivity analyses. Sensitivity analysis and evaluation was not included in the report issued by RAW on their library input cost index.

The AIR-Public Library Input Cost Index (PLICIa)

Fixed-Market-Basket Index and Inflation

Tables 8A, 8B, and 8C present the separate input cost indexes for each size category of public library—medium-, large-, and medium- or large-sized libraries, respectively. The first column in each table presents the descriptions of the budget categories. The last column in each table presents the budget shares used to calculate the total input cost index (i.e., the PLICIa) for public libraries (as was shown previously in table 3). The component input cost indexes are presented for each year in the analysis, 1988 through 1994. The total input cost index for each year is presented in the last row of each table. Table 8D lists the sources for the data in all of the tables.

It should be noted that the overall input cost indexes shown in tables 8A, 8B, and 8C were derived using the same methodology presented in the previous discussion on the FMB approach. Namely, each input cost index is multiplied by the expenditure budget weight corresponding to that input index. These values are then summed to create an overall input cost index. In theory, one could use these tables in order to "tailor-make" an overall input cost index for a specific library. One would substitute the expenditure budget weights applicable to a particular library, for the "typical" budget weights found in the tables below. Rather than multiplying the expenditure budget weight of a typical library by the corresponding input index, one would instead multiply the "tailor-made" expenditure budget weights by the corresponding input index. The sum of these multiplied values would yield a "tailor-made" overall input cost index. Moreover, the percentage change in this overall input cost index from one year to the next reflects the input inflation faced by that library.

The above approach may be helpful, for example, to library administrators who may wish to calculate an inflation index that reflects the increasing costs faced by their own libraries. However, one difficulty in the FMB approach presented in this report, and a difficulty that library administrators may face in calculating their own "tailor-made" index, is that one should attempt to measure increases in salaries over time that are due to inflation as opposed to changes in staff qualifications.

As discussed previously, the quality of the price data pertaining to acquisitions of nonprint media is dubious; however, these expenditures make up less than 4 percent of total expenditures and therefore have a small impact upon the total input cost index. It is important to note that, although the total input cost index shows a general increase in prices faced by public libraries during each year between 1988 and 1994, this does not mean that prices of all components of the index increased during each of the years. For example, between 1991 and 1992, the price of supplies and materials, noncapital equipment, and utilities fell. Prices of audio recordings increased between 1988 and 1991, but fell between 1991 and 1994. Also, video prices fell between 1988 and 1994.

A comparison of tables 8A and 8B shows that expenditures on salaries and wages of professional library staff in medium- and large-sized libraries did not increase at the same rate. Medium-sized libraries experienced a larger increase in professional staff salary and wage rates compared to larger-sized libraries during 1992–93 and during 1993–94. It should be noted that regional weighting is used in the use of ALA salary data.

Table 9 presents estimates of the rate of inflation in library services derived from the PLICIa in tables 8A, 8B, and 8C, along with two standard price indexes published by the BLS (i.e., the CPI and PPI). While the CPI and PLICIa numbers are quite similar, the PLICIa and PPI are different. This stems from the fact that the PLICIa makes use of CPI as well as PPI data, and inflation as reflected in the CPI has generally been the same or lower than inflation as reflected in the PPI.

Both the Consumer and Producer Price Indexes exhibit a lower rate of increase in prices than the public library input cost indexes. Stated another way, the PLICIa suggests that price inflation of library inputs is higher than inflation in the general economy. However, there appears to be a decline in the rate of inflation for both public libraries, as well as the general economy, between 1988 and 1994; in general, inflation appears to have been higher during the period before 1991 as compared with 1991 and after.

Table 8A.— AIR public library input cost index (PLICIa): Medium-sized libraries[1]

Type of Operating Expenditure (Source: Table 8D)	Input Cost Index (1991 = 100)							1991 Budget Percentage[2]
	1988	1989	1990	1991	1992	1993	1994	
Personnel Compensation								
Salaries and Wages								
Library directors (1)	86.62	88.72	93.12	100.00	108.03	114.07	119.74	22.9%
Other managerial staff (1)	79.35	84.69	93.70	100.00	107.28	113.54	115.89	3.1
Non-supervisory professional staff (1)	80.77	85.05	94.96	100.00	109.26	114.97	120.90	22.4
Support staff (2)	86.58	90.50	94.77	100.00	104.06	105.80	108.87	3.6
Fringe Benefits (3)	79.73	86.07	92.90	100.00	105.09	110.73	116.04	11.6
Acquisitions								
Printed Media								
Books and periodicals (4)	87.23	90.72	96.23	100.00	102.86	105.93	108.23	11.4
Other serials (e.g., newspapers) (5)	84.44	88.19	91.88	100.00	105.67	109.97	114.81	0.2
Other printed materials	--	--	--	--	--	--	--	0.3
Nonprint media								
Microforms (6)	87.67	93.82	89.51	100.00	102.03	108.93	113.68	0.7
Audio recordings (7)	83.09	86.86	85.96	100.00	96.31	67.32	72.41	0.6
Video (7)	149.90	117.88	116.42	100.00	67.15	49.48	43.87	2.0
CD-ROM (8)	107.65	112.19	120.08	100.00	111.97	120.55	122.73	0.1
Graphic images	--	--	--	--	--	--	--	0.1
Access (or on-line computer) services	--	--	--	--	--	--	--	0.2
Other Operating Expenditures								
Office Operations								
Office expenditures (9)	89.23	90.98	94.54	100.00	100.91	104.07	110.29	1.1
Supplies and materials (10)	93.36	98.82	99.37	100.00	98.74	99.20	102.06	4.5
Noncapital equipment (10)	94.75	97.26	99.40	100.00	99.77	100.34	100.11	0.2
Utilities (10)	84.65	86.74	93.18	100.00	99.81	105.69	107.62	7.0
Contracted Services (11)	89.27	94.47	97.18	100.00	101.71	103.94	106.42	7.8
Total Input Cost Index[3]	85.21	89.25	95.03	100.00	104.60	108.70	112.88	

[1] Libraries serving a legal service area of 25,000–99,999 persons.

[2] Budget percentages for broad categories (personnel compensation, acquisitions, other operating expenditures) from the U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Year FY1991. Budget percentages within broad categories and budget taxonomy from Halstead, K. (1995). *Inflation Measures for Schools, Colleges, and Libraries: 1995 Update*. Washington, DC: Research Associates of Washington. Budget percentages may not sum to 100 percent due to rounding. The budget share percentages are the same as those in table 3 corresponding to medium-sized libraries.

[3] Budget percentages corresponding to unavailable price series are set to zero in the calculation of total input cost index. Regional weighting was used in the calculation of price indices pertaining to compensation.

(--) Not available (unable to locate data or data do not exist)

SOURCE: See table 8D.

Table 8B.— AIR public library input cost index (PLICIa): Large-sized libraries[1]

Type of Operating Expenditure (Source: Table 8D)	Input Cost Index (1991 = 100) 1988	1989	1990	1991	1992	1993	1994	1991 Budget Percentage[2]
Personnel Compensation								
Salaries and Wages								
Library directors (1)	79.91	87.58	91.24	100.00	105.75	107.40	109.90	22.8%
Other managerial staff (1)	78.79	83.41	94.47	100.00	106.01	106.38	110.03	3.1
Non-supervisory professional staff (1)	78.63	84.15	93.44	100.00	107.78	108.76	111.75	22.3
Support staff (2)	86.58	90.50	94.77	100.00	104.06	105.80	108.87	3.6
Fringe Benefits (3)	79.73	86.07	92.90	100.00	105.09	110.73	116.04	11.6
Acquisitions								
Printed Media								
Books and periodicals (4)	87.23	90.72	96.23	100.00	102.86	105.93	108.23	11.0
Other serials (e.g., newspapers) (5)	84.44	88.19	91.88	100.00	105.67	109.97	114.81	0.2
Other printed materials	--	--	--	--	--	--	--	0.3
Nonprint media								
Microforms (6)	87.67	93.82	89.51	100.00	102.03	108.93	113.68	0.7
Audio recordings (7)	83.09	86.86	85.96	100.00	96.31	67.32	72.41	0.6
Video (7)	149.90	117.88	116.42	100.00	67.15	49.48	43.87	1.9
CD-ROM (8)	107.65	122.19	120.08	100.00	111.97	120.55	122.73	0.1
Graphic images	--	--	--	--	--	--	--	0.1
Access (or on-line computer) services	--	--	--	--	--	--	--	0.2
Other Operating Expenditures								
Office Operations								
Office expenditures (9)	89.23	90.98	94.54	100.00	100.91	104.07	110.29	1.2
Supplies and materials (10)	93.36	98.82	99.37	100.00	98.74	99.20	102.06	4.6
Noncapital equipment (10)	94.75	97.26	99.4	100.00	99.77	100.34	100.11	0.2
Utilities (10)	84.65	86.74	93.18	100.00	99.81	105.69	107.62	7.3
Contracted Services (11)	89.27	94.47	97.18	100.00	101.71	103.94	106.42	8.1
Total Input Cost Index[3]	84.06	88.74	94.27	100.00	103.72	105.67	108.44	

[1] Libraries serving a legal service area of 100,000 or more persons.

[2] Budget percentages for broad categories (personnel compensation, acquisitions, other operating expenditures) from the U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Year FY1991. Budget percentages within broad categories and budget taxonomy from Halstead, K. (1995). *Inflation Measures for Schools, Colleges, and Libraries: 1995 Update*. Washington, DC: Research Associates of Washington. Budget percentages may not sum to 100 percent due to rounding. The budget share percentages are the same as those in table 3 corresponding to large-sized libraries.

[3] Budget percentages corresponding to unavailable price series are set to zero in the calculation of total input cost index. Regional weighting was used in the calculation of price indices pertaining to compensation.

(--) Not available (unable to locate data or data do not exist)

SOURCE: See table 8D.

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Table 8C.— AIR public library input cost index (PLICIa): Medium- or large-sized libraries[1]

Type of Operating Expenditure (Source: Table 8D)	Input Cost Index (1991 = 100)							1991 Budget Percentage[2]
	1988	1989	1990	1991	1992	1993	1994	
Personnel Compensation								
Salaries and Wages								
Library directors (1)	81.95	88.44	93.66	100.00	107.46	112.41	117.30	22.9%
Other managerial staff (1)	79.22	84.37	93.89	100.00	106.97	111.77	114.44	3.1
Non-supervisory professional staff (1)	80.24	84.83	94.58	100.00	108.89	113.43	188.63	22.4
Support staff (2)	86.58	90.50	94.77	100.00	104.06	105.80	108.87	3.6
Fringe Benefits (3)	79.73	86.07	92.90	100.00	105.09	110.73	116.04	11.6
Acquisitions								
Printed Media								
Books and periodical (4)	87.23	90.72	96.23	100.00	102.86	105.93	108.23	11.3
Other serials (e.g., newspapers) (5)	84.44	88.19	91.88	100.00	105.67	109.97	114.81	0.2
Other printed materials	--	--	--	--	--	--	--	0.3
Nonprint media								
Microforms (6)	87.67	93.82	89.51	100.00	102.03	108.93	113.68	0.7
Audio recordings (7)	83.09	86.86	85.96	100.00	96.31	67.32	72.41	0.6
Video (7)	149.90	117.88	116.42	100.00	67.15	49.48	43.87	2.0
CD-ROM (8)	107.65	122.19	120.08	100.00	111.97	120.55	122.73	0.1
Graphic images	--	--	--	--	--	--	--	0.1
Access (or on-line computer) services	--	--	--	--	--	--	--	0.2
Other Operating Expenditures								
Office Operations								
Office expenditures (9)	89.23	90.98	94.54	100.00	100.91	104.07	110.29	1.1
Supplies and materials (10)	93.36	98.82	99.37	100.00	98.74	99.20	102.06	4.5
Noncapital equipment (10)	94.75	97.26	99.40	100.00	99.77	100.34	100.11	0.2
Utilities (10)	84.65	86.74	93.18	100.00	99.81	105.69	107.62	7.1
Contracted Services (11)	89.27	94.47	97.18	100.00	101.71	103.94	106.42	7.9
Total input cost index[3]	84.92	89.12	94.84	100.00	104.38	107.95	111.78	

[1] Libraries serving a legal service area of 25,000 or more persons.

[2] Budget percentages for broad categories (personnel compensation, acquisitions, other operating expenditures) from the U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Year FY1991. Budget percentages within broad categories and budget taxonomy from Halstead, K. (1995). *Inflation Measures for Schools, Colleges, and Libraries: 1995 Update*. Washington, DC: Research Associates of Washington. Budget percentages may not sum to 100 percent due to rounding. The budget share percentages are the same as those in table 3 corresponding to medium- or large-sized libraries.

[3] Budget percentages corresponding to unavailable price series are set to zero in the calculation of total input cost index. Regional weighting was used in the calculation of price indices pertaining to compensation.

(--) Not available (unable to locate data or data do not exist)

SOURCE: See table 8D.

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Table 8D.— Sources for tables 8A-8C: AIR public library input cost index (PLICIa) for medium-sized, large-sized, and medium- or large-sized libraries

(1) Salaries and Wages of Professional Library Staff: American Library Association, *ALA Survey of Librarian Salaries: ALA Survey Report*, Chicago and London: American Library Association, 1988-1994.

(2) Salaries and Wages of Support Staff: Educational Research Services, *National Survey of Salaries and Wages of Public Schools, Part 3, Wages and Salaries of Paid Support Personnel in Public Schools*, Arlington, VA: 1988-94.

(3) Fringe Benefits: Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-94.

(4) Books and Periodicals: Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-94.

(5) Newspapers: Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-94.

(6) Microfilm: Imre Jarmy of the U.S. Library of Congress.

(7) Audio Recordings and Video: Dana Alessi, *The Bowker Annual*, New Providence, NJ: R.R. Bowker, 1989-1995.

(8) CD-ROM: Martha Kellogg & Theodore Kellogg, and Pamela Mason, *The Bowker Annual*, New Providence, NJ: R.R. Bowker, 1989-1995.

(9) Office Expenditure: Bureau of Labor Statistics, *Producer Price Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-1994.

(10) Supplies and Materials, Noncapital Equipment, and Utilities: Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-1994.

(11) Contracted Services: Bureau of Labor Statistics, *Employment and Earnings Series*, Washington, DC: U.S. Department of Labor, Data Years 1988-1994; and Bureau of Labor Statistics, *Employment Cost Index*, Washington, DC: U.S. Department of Labor, Data Years 1988-1994.

Table 9.— Inflation faced by public libraries derived from the AIR (PLICIa)

	Rates of Inflation in Public Libraries[1] Based on the AIR (PLICIa)			Standard BLS Cost Indexes	
	Medium	Large	Medium or Large	Consumer Price Index	Producer Price Index
1988-89	4.74%	5.57%	4.95%	4.82%	5.19%
1989-90	6.47	6.24	6.42	5.40	4.93
1990-91	5.23	6.08	5.44	4.21	2.10
1991-92	4.60	3.72	4.38	3.01	1.23
1992-93	3.91	1.88	3.41	2.99	1.22
1993-94	3.85	2.62	3.55	2.56	0.64

[1] Inflation values based on the PLICIa derived from all of the sources listed in table 8D.

SOURCE: Bureau of Labor Statistics, *Consumer Price Index*, Washington, DC: U.S. Department of Labor, 1988–1994; Bureau of Labor Statistics, *Producer Price Index*, Washington, DC: U.S. Department of Labor, 1988–1994.

Table 10.— Public library inflation of small- and medium-sized libraries derived from the AIR (PLICIa)[1]

	Small-sized	Medium-sized
1988-89	4.20%	4.74%
1989-90	6.11	6.47
1990-91	4.88	5.23
1991-92	3.82	4.60
1992-93	3.51	3.91
1993-94	3.61	3.85

[1] Inflation values derived from all the sources listed in table 8D.

Because of the limitations of the available data, it is possible to develop an overall inflation rate for small libraries only under some fairly restrictive assumptions. First, no data on the costs of library inputs permit one to separate small from large libraries. Second, the ALA data on librarian salaries pertain only to libraries serving populations of 25,000 or more. Thus, in deriving an inflation index for small libraries, it is assumed that the salary index for small libraries is equal to the salary index for medium-sized libraries. Consequently, the reader should be cautious in interpreting the inflation rate for small libraries.

However, the differences in inflation that may be observed between small- and medium-sized libraries are those resulting from the different budget shares on the three major categories of library inputs (i.e., personnel compensation, acquisitions, and other operating expenditures) used to construct the overall PLICIa. Table 10 compares the overall inflation rates for small libraries with the inflation rates for medium-sized libraries (i.e., serving a population of 25,000-99,999), under the restrictive assumption that the salary index for small libraries is equal to that of medium-sized libraries. Although table 10 shows that there are some differences, they do not appear to be large. As mentioned above, there are no detailed data on the budget shares used by smaller libraries as opposed to larger libraries. Thus, the inflation rates depicted in table 10 for small libraries should be used with caution.

In summary, table 9 can be used by medium-sized and large-sized libraries as a measure of inflation faced by these libraries. (Table 9 shows separate values for medium- and large-sized libraries.) For small-sized libraries, table 10 is preferred over table 9, but the inflation rates depicted in table 10 should be used with caution. In any case, one purpose of this report is to create a public library input cost index (PLICIa) that builds and improves upon that created by RAW (PLICIb). However, the reader should decide which methodology is preferable.

Chapter 4. Empirical Analysis of Public Library Operating Expenditures and Development of the Public Library Cost of Services Index

The public library cost of services model (PLCSM), as outlined in chapter 2, is represented by a cost equation (1), which represents the relationships between the operating expenditures of public libraries and the levels of library service. The cost equation's account factors account for differences in the costs of inputs, and any changes in technology (e.g., through utilization of computers or new media) available for producing library services. In contrast to the public library input cost index (PLICI), which controls for the quantity and quality of input costs, the public library cost of services index (PLCSI) controls for the effect of the quantity and quality of library services on variations in operating expenditures. Using regression methods, a PLCSI can be developed based upon an analysis of annual changes in library operating expenditures, controlling for the level of library services or outputs provided to the public. By controlling for service levels, and by assuming that public libraries attempt to follow community preferences, one can also address the problem of potential input substitution by libraries in response to change over time in relative input costs or technology.

The regression model developed for this analysis uses data on individual public libraries from the Federal State Cooperative System (FSCS) database for the fiscal years 1989 through 1993. (The glossary includes a discussion of regression analysis, regression models, and econometric analysis.) The dependent variable is the total operating expenditures (measured annually). The library services measures are among the independent variables used in the analysis. (The glossary includes a discussion of independent and dependent variables.) The library services measures considered for this analysis include the following:[28]

- **Library visits**: the total number of persons per year entering the library, including persons attending activities, meetings, and those persons requiring no staff services.

- **Total circulation**: transactions that involve lending an item from the library's collection for use generally (although not always) outside the library. This activity

[28] For further discussion of library inputs, see DeBoer (1992), Bookstein (1981), and Cooper (1979). Definitions of library inputs are from *Public Libraries in the United States: 1991*.

includes charging materials manually or electronically. Each renewal is also reported as a circulation transaction. These data are reported as annual figures.

- **Reference transactions**: A reference transaction is an information contact which involves the knowledge, use, recommendations, interpretation or instruction in the use of one or more information sources by a member of the library staff. The term includes information and referral service. The information sources include printed and non-printed materials, machine-readable databases (including computer-assisted instruction), catalogs and other holdings, records, and through communication or referral, other libraries and institutions and persons both inside and outside the library. When a staff member utilizes information sources to answer a question, this is reported as a reference transaction even if the source is not consulted again during this transaction.

Other library services, such as interlibrary loan transactions and children's program attendance, were not included in the final equations, in part because of collinearity among the service measures (i.e., the service measures "move together" over time, which makes it difficult to sort out the independent effects of each service measure). The addition of interlibrary loan transactions and children's program attendance did not improve the fit of the regression equation model (that is, they did not "explain" the variation in operating expenditures among libraries). Thus, the analysis is not likely to be compromised by using only three output measures. In fact, prior studies of libraries have also used only a few output measures (e.g., DeBoer 1992).

As would likely be the case for any public service enterprise, there are a variety of complex interactions in the way library inputs are utilized to produce services. To reflect these complex interactions among library services, a mathematical model is used to represent the relationship between public library expenditures and library service measures.[29] This econometric analysis allows one to assess economies of scale and economies of scope associated with library services. For example, economies of scale would be said to exist if one determined that larger public libraries exhibit lower per unit costs of services. Economies of scope are reflected by cost reductions associated with joint production of different library services. Joint production refers to the production of two or more types of outputs (library services) simultaneously from the same combination of inputs. Thus, a broader range of types and levels of library services might be produced by the same set of inputs.[30]

One statistical problem in this analysis of public library cost of services is that the types of library services measured tend to move together (i.e., the output measures are collinear). For example, libraries with higher total circulation may also have higher levels of reference transactions, visits, and interlibrary loans. Correlations among these output measures are presented in table B.10 in appendix B of this report. For example, the pairwise correlations between total circulation and the other library service measures range from about .72 to .89. This collinearity among the outputs makes it difficult to isolate the impact on

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[29] To reflect the complex interrelationships between expenditures and this array of services, the econometric model used to conduct this analysis is specified as what economists refer to as a transcendental-logarithmic cost function. The dependent variable (library expenditures), as well as the library output measures, are all expressed in logarithmic form, and the elements of the equation capture the linear, quadratic, and all possible interaction terms among all of the types of outputs. The mathematical formulation of the equation for this econometric model is presented in its most general form in appendix A of this report. The actual empirical estimates of the parameters of the model are presented in the tables in appendix B.

[30] For example, see the discussion of economies of scope in Chressanthis (1995).

cost of any one service.[31] This could be problematic if the purpose of this analysis were to measure the effects of any one service level on cost. That is, the collinearity would make it difficult to isolate the effects of any one of the types of outputs when they all move together over time. However, the purpose of this analysis is to control for the variations in the overall level of library services on total operating expenditures in order to isolate the impact of inflationary pressures.

The library service measures selected do not exhaust all the outputs that might be included in this kind of cost analysis. For example, one might include measures of client use of "special programming," e.g., the number of children who attend storybook sessions, or the number of adults who attend literacy programs. One might also include measures of the quality of library services. For example, what is the level of public satisfaction with services among clients who utilize the local branch of the public library? Unfortunately, these more detailed measures of library outputs are not available for the present study. However, as suggested above, even with the more limited service measures available one observes a fair amount of collinearity among the service measures. Such collinearity may also exist with the service measures described above. It is assumed for the purpose of this analysis that some of the more elaborate library service measures will be correlated with the measures of library services included in the analysis. To the extent that this is the case, variations in the levels of the more elaborate service measures will be partially controlled for in the PLCSI.

A series of locational indicators (i.e., dichotomous variables; see glossary) are also included in the econometric model in order to control for geographic differences in the costs of library inputs and/or other factors that might affect the way public libraries operate within different states or regions of the country. Specifically, the state in which the library operates is identified, as well as whether the outlet of the library is located within a metropolitan or non-metropolitan area. These two factors should capture some of the systematic patterns of variation in the costs of library inputs and differences in the regulatory or administrative environment within which libraries operate across the United States. Finally, to capture the effects of inflation, a series of indicator variables (i.e., again dichotomous variables) for the calendar year are included in the econometric model.

As part of this econometric analysis, a variety of models were applied to the data. (The glossary includes a discussion of regression analysis, regression models, and econometric analysis.) The purpose of these alternative models was to determine what differences, if any, in the estimates of inflation result from using more complex econometric specifications. These alternative models include equations estimated by unweighted ordinary least squares (OLS) analysis, weighted least squares (WLS) analysis, and weighted two-staged least squares (2SLS) analysis. They also include models using different numbers and combinations of types of library services, and models estimating separate equations for public libraries serving different size communities (e.g., small libraries, and medium to large libraries, corresponding to populations of less than 25,000 and 25,000 or more, respectively).

In general, the econometric models explain more than 90 percent of the variance in the logarithm of total operating expenditures, or about 70 percent of the variance in the logarithm of total operating expenditures per capita in the service area of the library. While models with more measures of library service do explain a greater percentage of the variance, the addition to explained variance resulting from adding one more service measure is quite small. For example, a model that includes total circulation per

[31] A discussion of elasticities of costs with respect to the public library outputs is included in appendix B along with table B-10.

capita as the only library service measure explains 68 percent of the variance,[32] while a model that includes total circulation per capita, reference transactions per capita, and library visits per capita explains 71 percent of the variance. That is, most of the variance can be explained by including a single measure of service levels along with the locational and time indicators. The various types of library service measures do tend to move together (i.e., exhibit collinearity) which means that, to some degree, the variations in the levels of all types of library outputs can be represented by any one of these measures.

A few caveats should be noted about the use of FSCS data in this analysis. In particular, there is variation among states in the fiscal year reporting periods used, along with some variation in definition of the above library service measures; the definition used by some states might not be consistent with those used by the Federal-State Cooperative System. The sample size used in the analysis is the total number of observations (summed across the years) for each public library for which there are complete data applicable to the cost equation over the five year period from 1989 through 1993. The same public libraries were used in each of the five data years.

Three Methodologies: OLS, WLS, and 2SLS

As mentioned above, three methodologies are used in the regression analysis: OLS, WLS, and 2SLS. To obtain unbiased and efficient estimators of the parameters of a regression model using ordinary least squares (OLS) requires certain statistical assumptions to be true. First, OLS requires one to assume that the standard error of the predicted value of total operating expenditures is constant among subgroups. Unfortunately, analysis suggests that this first assumption is violated. In particular, the standard error of the estimates tend to be higher in libraries serving smaller service areas, as measured by population.[33] Economists typically address violations of this assumption by using weighted least squares (WLS) estimates. In particular, the regression estimation was weighted by the logarithm of the population of the legal service area.

A second assumption pertains to the interpretation that the OLS coefficients represent the effect of changes in the independent variables upon the dependent variable. In particular, OLS generally assumes that the independent variables in the analysis (e.g., the levels of the various types of library services) are exogenous: that is, there is no correlation between the independent variables used in the analysis and the error term in the regression. In the specification of the public library cost of services model (PLCSM) earlier in this report, it is assumed that library decisionmakers maximize the level of services subject to a budget constraint. But, in fact, decisions about the library budget may be determined in conjunction with decisions about the allocation of resources among public services. That is, local public officials must ultimately decide how much funding to provide libraries. These decisions involve a series of implicit trade-offs between the level of library services, other public services, and the tax burdens that local public officials are willing to impose on the local community to support the library. In effect the willingness of the community to spend on library services may be inextricably linked to the decisions about allocating public

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[32] See column 3 versus column 4 in table 11.

[33] For example, the percentage of variance of per capita expenditures that is explained by the OLS regressions among libraries serving a population below the median level is 59.79 percent. Among those serving a population above the median, 78.97 percent of the variance is explained. Economists refer to this statistical problem as heteroskedasticity. The impact it has on the statistical analysis is that it tends to inflate the estimates of the standard errors of the parameters of the equation. The F-statistic corresponding to the test of heteroskedasticity is 1.75, which exceeds the critical value of 1.19 at the .05 level. The use of appropriate weights, such as population of the legal service area in the case of public libraries, allows the analyst to obtain better estimates of the standard errors.

library budgets among inputs. Citizens who care enough about a particular aspect of public services have opportunities to discuss the quality of these public services, complain to providers or compliment them when appropriate, and lobby for changes. Citizens who are apathetic, indifferent, or even hostile to public services of any sort have ample opportunities to vote for tax cuts and to oppose all forms of public expenditure.

From a statistical standpoint, the same factors that affect the relationship between library services and costs also affect the demand for library services. That is, variations in the costs of library inputs and variations in the factors that affect the technology by which library services are produced affect the cost of library services and hence the demand for services. Because of these interrelationships between the demand for library services, the level of services, and costs, there may be a correlation between the service measures included in the PLCSM and the error term in the regression equation, and this creates the potential for bias in the regression equation estimations. (See the glossary for an explanation of regression equations, dependent variables and independent variables.) In other words, estimations of regression equations generally assume that the error term in the regression equation (the dependent variable observations unexplained by the independent variables) is not correlated with the independent variables. When this assumption is violated, is may lead to a bias estimation of the effect of the independent variables on the dependent variable.

With these concerns in mind, it may be necessary to use more sophisticated econometric modeling techniques. For this purpose, both weighted least squares (WLS) and weighted two-stage least squares (2SLS) estimators have been derived for this analysis. The weighted 2SLS requires use of an initial stage equation that estimates the demand for library services (the library output measures) as a function of a series of exogenous variables, including the size of the population of the legal service area, the median county income, the poverty rate in the county, the median housing value in the county, the percentage of the population in the county with a high school degree, and the level of state and federal grants supporting the operations of local public libraries.[34] These explanatory variables are the factors underlying the variations in the demand for library services. The second stage uses these predicted values from the first stage as independent variables in the cost equation that represents the PLCSM. This procedure is designed to remove the statistical bias that may be present in the parameters of the standard OLS model. The WLS procedure is designed to remove the bias that may be present in the estimation of the standard errors of the parameters (a measure of the accuracy of the parameter estimates) derived from the OLS procedure. By using a weighted procedure, the standard error of the estimates will provide a more accurate measure of the reliability of the parameter estimates. The weighted 2SLS procedures are less likely to be statistically-biased compared to those generated by the OLS and WLS procedures.

Table 11 offers a comparison of the various econometric models used to derive estimates of inflation in public library services.[35] The models are distinguished according to the statistical methods of estimation (i.e. OLS, WLS, and 2SLS) and by the types of library service measures used as control variables

[34] Since data on median family income, poverty rate, median housing value, and percent of the population with a high school degree are not available for the actual local community served by the library, data for the county in which the library is located are used for the econometric analysis of demand for library services. All of these variables were from the 1990 County and City Databook (data year 1989), except for the size of the population of the legal service area, which was derived from the FSCS data set. It would be preferable to have data on these explanatory community variables derived from the actual community served by the library.

[35] Appendix A presents the calculations required to estimate the index of public library costs and inflation rates from the regression parameters.

(see glossary). Table 11 shows the cost of services index and the corresponding inflation rates associated with each model and an indicator of how well the data fit the model, as measured by the percentage of the variance in the dependent variable explained by the independent model (i.e., R-square). Column 1 shows the results from an OLS analysis using three library service variables (circulation per capita, reference transactions per capita, and library visits per capita), and using total operating expenditures per capita as the dependent variable. Column 2 shows results from the same OLS regression, but using only one library service variable (circulation per capita). The regression results shown in columns 3 and 4 make use of the same regression analysis as in the OLS model used in columns 1 and 2, but also use weighted least squares (WLS) analysis. Column 5 makes use of weighted two-stage least squares (2SLS). Finally, column 6 shows results from a WLS analysis using the three library service variables (similar to column 4). However, column 6 differs from the other columns (1 through 5) in that the dependent variable and the library service variables are not specified in per capita terms. It should be noted that the estimates of inflation obtained for any given pair of years are not significantly statistically different from one another. For example, equations 1 and 3 estimate inflation in library services at 6.3 and 6.0 percent, respectively, between 1989 and 1990. These two estimates cannot be said to be statistically significantly different.

Table 11 shows that the use of three library service variables compared with only one variable (circulation) does not greatly improve the fit of the regression equations, although the improvement is statistically significant.[36] However, the use of the three library service variables tends to yield slightly lower rates of inflation than models using only one library service variable. That is, adding outputs to the equation permits the analyst to control for other factors that affect costs, while attempting to estimate the effects of inflationary pressures. The use of WLS, as compared with OLS, results in similar estimates of inflation, and though they are not statistically different from one another, they are consistently smaller in magnitude. Comparing the inflation rates of equations 1 versus 3 and equations 2 versus 4 in a pairwise manner, the differences are as small as 0.03 percent to as high as 0.38 percent lower for the WLS equations. It should be noted, though, that the fit of the regression equations, as measured by the R-squared statistic, is similar with the use of WLS as compared with OLS.

[36] The F-statistic equals 347.57, which exceeds the critical value of 2.64 at the .05 level.

Table 11.—Public library cost of services index and inflation rates, using various methodologies (fiscal years 1989–1993)

Methodology	OLS	OLS	WLS	WLS	2SLS	WLS
Library Services Variables	Per Capita Circulation Per Capita Reference Transactions Per Capita Library Visits	Per Capita Circulation	Per Capita Circulation Per Capita Reference Transactions Per Capita Library Visits	Per Capita Circulation	Per Capita Circulation	Circulation Reference Transactions Library Visits
Dependent Variables	Per Capita Total Operating Expenditures	Per Capita Total Operating Expenditures	Per Capita Total Operating Expenditures	Per Capita Total Operating Expenditures	Per Capita Total Operating Expenditures	Total Operating Expenditures
	(1)	(2)	(3)	(4)	(5)	(6)
Public Library Cost of Services Index (1991 = 100)						
1989	90.99	89.36	91.42	89.79	89.86	93.49
1990	96.75	95.56	96.90	95.68	96.79	98.08
1991	100.00	100.00	100.00	100.00	100.00	100.00
1992	102.38	102.57	102.24	102.39	102.85	101.30
1993	106.74	107.54	106.55	107.33	107.99	105.13
Derived Rate of Inflation						
1989-90	6.34%	6.94%	6.00%	6.56%	7.72%	4.91%
1990-91	3.36	4.65	3.20	4.51	3.32	1.95
1991-92	2.38	2.57	2.24	2.39	2.85	1.30
1992-93	4.26	4.85	4.21	4.82	5.00	3.78
Adjusted R-squared	0.6907	0.6629	0.7064	0.6794	0.3709	0.9346
Sample Size	26,420	26,420	26,420	26,420	26,420	26,420

Note: "OLS" is Ordinary Least Squares. "WLS" is Weighted Least Squares. "2SLS" is Two Stage Least Squares. All of the WLS and 2SLS regression analyses were weighted by the population of the legal service area. Per Capita refers to the population of the legal service area. The independent variables are specified in a transcendental-loganthmic form. The dependent variable is specified in a loganthmic form. The sample size used in the analysis is the total number of observations (summed across the years) for each public library for which there are complete data applicable to the cost equation over the five year period from 1989 through 1993. The same public libraries were used in each of the five data years.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Fiscal Year 1989-1993; U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, County and City Data Book, 1990 (1989 data).

The last column in table 11 (column 6) presents a model expressed in total, rather than per capita, operating expenditure. This model is estimated simply to determine whether the expression of the public library cost of services model in this alternative form makes a significant difference in these estimates of inflation. Only the WLS model with the largest variance explained is used for this comparison for the sake of simplicity. The higher percent of variance explained (.9347 in column 6 versus .7071 in column 3) by this model results from the fact that the dependent and independent variables are not specified in per capita terms. The inflation rates derived from the total operating expenditure model (column 6) are somewhat lower (though not statistically significantly so) than those shown in the WLS model column 3, where variables are specified in per capita terms. This suggests that the inflation estimates may be somewhat sensitive to the use of per capita versus non-per-capita variables in the regression equation. It is suggested that further research comparing these alternative specifications may be worth pursuing in future studies of public library operating expenditures.

Nevertheless, each of the models in table 11 show the same basic pattern of variation, even though the magnitudes are somewhat different. In particular, the rate of inflation is greatest between 1989 and 1990, declines between 1990 to 1991 and 1991 to 1992, and increases between 1992 and 1993.

It should be noted that the estimated standard errors pertaining to the variables used in the per capita regression equation to calculate inflation are smaller than the estimated standard errors pertaining to the variables used in the non-per-capita regression equation to calculate inflation (see appendix B for standard errors). In other words, while the fit of the non-per-capita regression equation (column 6) is better than the fit of the per capita regression equation (column 3), the index values derived from the per capita regression equation are more reliable.

The reader may like to know which of the several methodologies depicted in table 11 is preferable. However, each of the methodologies shown in table 11 produces similar results. This shows that the inflation values produced in table 11 do not appear to be sensitive to the type of methodology used. In any case, the reader may prefer using values obtained by the WLS methodology using the three output measures (column 3) simply because the overall fit of the model and the standard errors of the inflation estimates (as shown in appendix B) are slightly better than the other models. For purposes of this report, references to the PLCSI refer to the WLS methodology represented in table 11, column 3.

Table 12.— Public library cost of services index and inflation rates faced by various size libraries, using weighted least squares regression analysis

	Small Libraries[1]	Medium and Large Libraries[2]	All Libraries
Public Library Cost of Services Index (1991 = 100)			
1989	96.08	94.18	91.42
1990	96.31	98.43	96.90
1991	100.00	100.00	100.00
1992	102.53	101.06	102.24
1993	107.14	104.77	106.55
Derived Rates of Inflation			
1989-90	6.92%	4.51%	6.00%
1990-91	3.83	1.60	3.20
1991-92	2.53	1.06	2.24
1992-93	4.50	3.67	4.21
R-squared	0.6886	0.7984	0.7064
Sample Size	20,862	5,558	26,420

[1] Small libraries are defined as serving a population of legal service area below 25,000.
[2] Medium and large libraries serve a legal service area population of 25,000 or more.
Note: The methodology used corresponds to that used in column 3 of table 11. All three measures of pubic library service levels (i.e., circulation, reference transactions, and library visit levels) are included in the regression analyses which underlie these estimated inflation rates. The sample size used in the analysis is the total number of observations (summed across the years) for each public library for which there are complete data applicable to the cost equation (listed below) over the five year period from 1989 through 1993. The same libraries were used in each of the data years.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Years FY 1989-93.

How do the rates of inflation vary for public libraries located in different size communities? To address this question, separate equations are estimated for small (serving a population below 25,000) and the combination of medium and large public libraries. Based on these two equations, table 12 compares the inflation rates for small libraries with those for medium and large libraries, using WLS analysis, with the three library service variables expressed in per capita terms (as in column 3 of table 11). Smaller libraries appear to have had a higher rate of inflation between 1989 and 1993 compared with medium and large libraries,[17] and a relatively smaller percentage of the variance is explained in the small libraries relative to the equation for the large and medium public libraries (i.e., the R-squared statistics is .6895 for the small and .7970 for the large and medium public libraries).

[17] The F-statistic for differences in inflation between small versus medium and large libraries equals 10.82, which exceeds the critical value of 3.84 at the .05 level.

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Chapter 5. Concluding Remarks

The purpose of this report has been to develop an index of inflation for public libraries. A measure of inflation is intended to reflect changes in the cost of public library services over time. This sounds fairly simple, but is, in fact, quite complex.

This report presents two approaches to measuring inflation for public libraries: a fixed-market-basket (FMB) approach and an approach based an econometric model of public library services and costs (public library cost of services model—PLCSM). The FMB approach measures inflation by assessing changes in the costs of the inputs public libraries use to provide services. The FMB approach produces an index that is a weighted average of the indexes of the costs of public library inputs (PLICI). From the FMB approach, one can determine an average rate of inflation in the costs of these public library inputs, where the budget shares used to aggregate these individual inputs are the average proportions of public library budgets allocated to each input category.

The PLCSM approach measures inflation by trying to isolate the changes in the cost of public library services such as circulation, reference transactions, and library visits over time. The PLCSM produces estimates of inflation based on an econometric model designed to explain the variations in public library costs and operating expenditures over time. Specifically, this econometric model isolates the systematic patterns of variation in public library costs over time (i.e., the measure of inflation) by controlling for variations in operating expenditures associated with changes in the level of library outputs or services (e.g., the level of circulation, reference transactions, and library visits), differences in geographic location, and the population of the legal service area.

The FMB approach, which is embodied in the PLICI, measures changes in input costs and generates the PLCSI. The PLCSM measures changes in library service costs and generates the PLCSI. What is the difference? Don't input costs translate into output costs? The following discussion explores this difference a bit further.

The Input Cost Index Versus the PLCSM

A significant advantage of the input cost index is that it is fairly simple to calculate and understand. It is essentially nothing more than a weighted average of changes in the costs of the components of public library operating expenditures: that is, the prices of the personnel and non-personnel inputs purchased by libraries to permit the provision of library services. Indeed, the input cost index

approach is familiar to people because it is similar to the approach that has been used by the Bureau of Labor Statistics (BLS) for decades in the production of the Consumer Price Index (CPI). In fact, it is intended as a representation of the changes in the cost of producing public library services. After all, one would expect that the changes in input costs would also change costs of library services.

The problem is that the input cost index approach does not account for potential input substitutions in response to changes over time in relative input prices or changes in technology, both of which may affect the way public library inputs are combined to produce services. This has been a well-known criticism leveled at the CPI for years, and one that has received attention in the popular press and among economists. First, changes in the relative cost of different library inputs may cause library decisionmakers to alter the combinations of inputs used to produce library services. For example, if the wages required to attract a well trained librarian increase relative to the wages required to attract a lower level library aide, one might expect libraries to increase their use of relatively lower cost help combined with more on-the-job training to provide library services. That is, the same level of public library services may be produced by varying combinations of highly trained librarians and library aides who have less training.

Second, changes in technology such as better and faster computers and more accessible software for managing public library services may cause changes in the composition of library spending as libraries seek to take advantage of new technology. Such changes impact inflation by changing the composition and even kinds of inputs purchased and utilized to produce any given level of library services.

The PLCSM focuses attention on the cost of public library services (e.g., circulation, reference transactions, and library visits). By focusing on outputs, this approach accounts for the effects of input substitution and technological change on the estimates of inflation. The PLCSM uses econometric techniques to isolate changes over time in public library expenditures, while controlling for variations in the level of library services. Technological change and input substitutions are embedded in the changes in the composition and levels of the various types of public library services which are offered. In this sense, the PLCSM approach offers a potentially more accurate measure of inflation compared with the FMB approach.

For the most part, this econometric model is produced using data from NCES Federal State Cooperative System (FSCS) data on public libraries, although a more complete model might require more detailed information on the demographic characteristics and fiscal capacity of local governments responsible for supporting public library budgets and more detailed and accurate information on the costs of comparable inputs over time and across geographic locations. Nevertheless, the simple econometric model presented in this report relies primarily on a single data source (FSCS data) and produces estimates of the rates of inflation that are comparable in magnitude (as one would expect) to the input cost index.

A Comparison of the Alternative Estimates of Inflation

Table 13 contains inflation rates based upon three alternative indexes of inflation for public libraries. The first two columns present the public library input cost index developed by the American Institutes for Research (PLICIa) and the public library input cost index developed by the Research Associates of Washington (PLICIb) versions of the input cost index applied to public libraries. The next two columns present the CPI and PPI for comparative purposes. All of these first four indexes are based on an input cost index methodology: the first two are based on public library inputs and the second two are based on goods and services commonly purchased by consumers and producers, respectively. The last column presents the PLCSI based on the weighted least squares econometric model (see table 11,

Table 13.—Comparison of inflation rates derived from various sources and methodologies, in percentages

Methodology	Derived from Fixed-Market-Basket Input Cost Indexes				Derived from Cost of Services Index
	AIR-FMB[1] (PLICIa)	RAW-FMB (PLICIb)	CPI	PPI	AIR-PLCSM[2] (PLCSI)
	(1)	(2)	(3)	(4)	(5)
1988-89	5.0%		4.8%	5.2%	
1989-90	6.4		5.4	4.9	6.0%
1990-91	5.4		4.2	2.1	3.2
1991-92	4.4	--	3.0	1.2	2.2
1992-93	3.4	1.5%	3.0	1.2	4.2
1993-94	3.6	2.7	3.6	0.6	--
1994-95	--	3.0	--	--	--

[1] The AIR-FMB inflation values pertain to libraries with the population of the legal service area of 25,000+. See table 9, column 3.
[2] The AIR-PLCSM inflation values (PLICIa) pertain to libraries with a population of the legal service area of 25,000+. The methodology used corresponds to that used in table 11, column 3.
(--) Not available.
SOURCE: Halstead, K. (1995). *Inflation Measures for Schools, Colleges, and Libraries: 1995 Update*. Washington, DC: Research Associates of Washington. The AIR-FMB inflation rates derived from all sources listed in table 8D. The AIR-PLCSM inflation rates derived from the U.S. Department of Education, National Center for Educational Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey. Data Years FY1989-93.

column 3) and controls for variations in costs related to three output measures (i.e., circulation, reference transactions, and library visits) and locational indicators. (The PLCSM analysis excluded 1988 FSCS data expenditure data from the analysis because it was incompatible with the data from the remaining years used in this study.)

The years corresponding to the indexes developed by the American Institutes for Research (AIR) depend upon the years for which the source data sets are available. It should be noted that Research Associates of Washington (RAW) has not published an index covering years prior to 1992. This is in part due to the fact that RAW depends upon source data that are relatively new. For example, the 1995 index developed by RAW makes use of preliminary 1995 CPI and PPI data.

The inflation rates reflected in the PLICIa (column 1) exhibit roughly the same pattern of change as the CPI (column 3) between 1988-89 and 1993-94, though the magnitudes of the rates of inflation in libraries is higher than consumer prices based on these estimates. In general, the PPI (column 4) shows lower rates of inflation in all years except between 1988 and 1989. The similar patterns between the PLICIa and the CPI are not surprising, since several components of the CPI are used to calculate the input cost index of various public library expenditure categories in the PLICIa approach.

The higher rates of inflation reflected in the PLICIa relative to the CPI and PPI may be due to the high rates of salary increases among professional library staff, as shown in the American Library Association (ALA) survey of librarian salaries (see table 5). These salary increases appeared to have exceeded increases in the cost of living, as reflected in the CPI. On the other hand, the PLICIb (i.e., the index developed by the RAW), which de-emphasizes the use of the ALA data, yields inflation rates between 1992-93 and 1993-94 that are closer to inflation rates in producer prices (PPI). As discussed previously, however, the PLICIb

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Table 14.—Comparison of average inflation rates derived from various sources and methodologies, in percentages

Methodology	Derived from Fixed-Market-Basket Input Cost Indexes				Derived from Cost of Services Index
	AIR-FMB[1] (PLICIa)	RAW-FMB (PLICIb)	CPI	PPI	AIR-PLCSM[2] (PLCSI)
	(1)	(2)	(3)	(4)	(5)
1989-93	4.3%	--	3.9%	2.4%	3.9%

[1] The AIR-FMB inflation values pertain to libraries with the population of the legal service area of 25,000+. See table 9, column 3.
[2] The AIR-PLCSM inflation values (PLICIa) pertain to libraries with a population of the legal service area of 25,000+. The methodology used corresponds to that used in table 11, column 3.
(--) Not available.
SOURCE: The AIR-FMB inflation rates derived from all sources listed in table 8D. The AIR-PLCSM inflation rates derived from the U.S. Department of Education, National Center for Educational Statistics, Federal-State Cooperative System for Public Library Data, Public Library Survey, Data Years FY1989-93.

emphasizes the use of data from the BLS Employment Cost Index (ECI), which may be an inappropriate data source for deriving a public library personnel salaries index.

Inflation rates derived from the PLCSI (table 13, column 5) show lower rates of inflation than those derived by the PLICIa (column 1). This is consistent with the theory that the cost of services model should control better for increases in the costs of public library services due to improvements in the level of services that may result from technological change.[18] Unlike the inflation rates corresponding to the FMB approach (columns 1-4), the cost model yields a rise in inflation between 1991-92 and 1992-93. It is unclear why this cost of services model yields these different results, although the PLICIb yields a pattern of increasing inflation after 1992. Unfortunately, a thorough comparison of the PLICIb results with those of other indexes is difficult, since they have been published only for the years after 1992-93. This may be due to the fact that the PLICIb relies upon data only recently available.

Table 14 compares average annual inflation rates between 1989 and 1993 derived from various sources and methodologies. The PLCSI (i.e., the index based on the public library cost of services model) exhibits an average annual rate of almost 4 percent from 1989-93 compared to 4.3 percent rate of inflation estimated by the FMB model (PLICIa) for this same period. Consumer prices (CPI) also rose at an average annual rate of almost 4 percent, while procedure prices (PPI) rose only 2.4 percent over this same period.

[18] For example, as in the rest of the economy, the demand for skilled workers might have increased relative to unskilled workers. Therefore, total employment of library staff might have fallen, but those who remain might command higher salaries. These remaining librarians might have the necessary skills (e.g., computer skills) that are required to run a modern library. The input cost index approach would not adjust for the increase in the skill level of librarians, and increases in library salaries might in part result from higher quality library staff. This would upwardly bias the input cost index.

Implications for NCES: How to Measure Inflation

How does one choose between these two approaches? Frankly, both approaches as they have been presented in this report and implemented by the practitioners in this field require further research with better data. The PLICI approach appears simpler. One can more easily understand the data components and manipulations required to implement the FMB approach. Specifically, the FMB approach requires a collection of input cost indexes for each of the library inputs and the budget shares used to aggregate them into a single index. Moreover, this methodology is quite familiar to anyone who is aware of the CPI, which has been published by the BLS for decades.

In contrast, the PLCSM relies on the analytical tools of the economist which may appear to the non-economist as a bit of a black box. At the same time, the econometric techniques applied in this report to analyze the costs of public library services have been used for decades by economists to examine production and costs in many industries. Moreover, this methodology has been utilized previously by economists to analyze the costs of library services (e.g., see Chressanthis 1995, DeBoer 1992).

The difference between the two lies in the emphasis on input costs versus output costs. The input cost index assumes that libraries do not change the way they provide services in response to changes in costs of inputs or technologies. The PLCSM incorporates the behavior of public library decisionmakers in altering the composition of inputs in response to changes in input costs and technology. It does this by using more sophisticated modeling and statistical techniques and by focusing on the library service measures.

But does the PLCSM account for all of the library services, and are these services measured accurately? Does it capture appropriately the impact of changes in the relative costs of library inputs? Both the PLICIa and the PLCSI could be improved through improvements in the way library input costs are measured.

To make the PLICIa less cumbersome to calculate, NCES could incorporate into FSCS data collection a number of significant items of data currently obtained from non-NCES sources. Presently, the calculation of the PLICIa index requires the collection of cost information on public library inputs from a variety of sources. For example, salary information on librarians, presently collected by ALA could be instead collected by NCES. As mentioned in the discussion of operating expenditure budget shares, personnel compensation makes up a large percentage of total library operating expenditures, and therefore the quality of data pertaining to salaries is vital. The collection of salary information for use in the FSCS data set would also allow for proper representation of public libraries by size and region. The ALA data set currently excludes libraries serving populations of less than 25,000.

Information on the scheduled salaries and the full-time-equivalent (FTE) salaries paid to various categories of library staff should be collected. To obtain scheduled salaries, the FSCS would request data on the salaries paid to various categories of library personnel with certain educational attainments and experience levels. For example, one might request the salaries paid to a beginning librarian and one with 5 years of experience, each with a master's degree in library science. By asking for the total expenditures for each category of library staff and the numbers of FTE personnel, one could then calculate the average salary paid to full-time staff. In addition, more accurate data on appropriate budget shares used for the development of input cost indexes could be obtained for personnel.

A major problem with all of the salary indexes used in this report is that none of them are adjusted for differences in the attributes of the workers over time. Changes over time in the composition of the library work force with respect to educational preparation, job experience, or other attributes that may make workers more valuable are currently reflected in all of these salary indexes. That is, a portion of the observed growth in the salaries over time might be a result of increases in the average levels of attributes, such as educational preparation and job experience. Since these factors presumably make workers more valuable and more productive over time, they should be excluded from any estimates of inflation in library services.

To illustrate the potential impact of adjusting for differences in personnel characteristics in estimating inflation in salaries, compare the inflationary estimates by Chambers (1997) and RAW for public school teachers.[39] The measure of inflation in teachers' salaries used by RAW consists of data on changes in the average salaries of public school teachers over the period 1987 to 1990. The RAW estimate for this change in average teachers' salaries is almost 17 percent. According to Chambers (1997), an index of inflation in teachers salaries which controlled for the attributes (e.g., experience, educational preparation, and other background characteristics) of teachers exhibited a rate of increase of 16 percent. In the subsequent three year period of 1990 to 1993, RAW estimates that the average salaries of public school teachers increased by 11 percent, while the Chambers inflation estimate controlling for teacher attributes is over 10 percent. Thus, using average salaries results in potentially different estimates of inflation than the use of salaries which are adjusted for the characteristics of workers.

To resolve this measurement problem would require maintaining a database of detailed information on compensation and characteristics of individual public library workers much like the one that has been developed for the *Schools and Staffing Survey* administered by NCES for individual teachers and school librarians. As mentioned previously, such a database could be used to develop more accurate estimates of salary differences over time by allowing the analyst to adjust for differences in the qualifications of library personnel. Such data could be collected in connection with the NCES Public Libraries Survey by adding a questionnaire designed to be answered by individual public library staff regarding their compensation, personal background, professional qualifications, and working conditions.

Another vital cost series involves the cost of books and periodicals. The PLICIa, which makes use of the CPI covering books, magazines, and periodicals, may not represent the typical books and periodicals purchased by libraries. In addition to information related to salaries and the cost of books and periodicals, data on expenditures and quantities purchased of the following items would enable the FSCS data set to be used more effectively to create a public library input cost index: supplies and materials, utility services, and contracted services.

Another vital component of an input cost index regards budget shares. Both the PLICIa and the PLICIb rely heavily upon a survey of New York State public libraries for the budget shares of subcategory operating expenditures.[40] As mentioned previously, this study disproportionately excludes smaller libraries, and therefore one should apply the findings presented in this report to smaller libraries with caution. Rather than relying upon the New York State Library study to develop an FMB index representing smaller libraries, the FSCS data set could instead include information on subcategory budget shares, similar to those used in the New York State Library study.

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[39] In the same document in which RAW produces the library input cost index, RAW also publishes a School Price Index which uses the same FMB methodology and same types of data sources for measuring the prices of school inputs.

[40] See New York State Library (1992).

Better information on budget shares across individual libraries or even for the nation as a whole could also permit analysts to try out some of the more sophisticated approaches to using alternative input cost indexes which economists have tried to apply to approximating the *true* cost-of-living index. Such experimental measures would require more detailed data on how budget shares have changed over time for the nation's public libraries. A discussion of these methods to estimate what economists have called *superlative* cost indexes is contained in Diewert (1976).

Presently, much of the data used for the PLCSM come from the FSCS data set. Although the FSCS data provides a core measurement of public library services, NCES might consider the need for adding service measures. Are there other measures of the quantity or quality of public library services that need to be accounted for in this kind of cost analysis? For example, has the advent of computer technology and the internet created new dimensions to public library services that are not adequately reflected in the current services data? This would suggest that the FSCS data set should include measures such as the number of library visitors making use of the library's internet services, or the total number of hours visitors make use of such services. Moreover, what is the effect of program attendance on the cost of running a public library? Do expenditures on programs aimed at certain populations (e.g., the elderly, the educationally disadvantaged) reflect differential needs among library users for such programs?

Finally, the 2SLS regression results presented in this report for the public library cost of services model make use of county-level demographic, income, and wealth data from the Bureau of the Census; but these data are imperfect measures of the demographic, income, and wealth data of the local communities actually served by the public libraries. Census data on the cities or local jurisdictions actually served by public libraries could be used to improve the quality of this information, which underlies the analysis of demand for library services. The linking of such census data to the FSCS data set can be facilitated by including in the FSCS data set a variable indicating the applicable census metropolitan code.

Concluding Remarks

This report utilizes some commonly used econometric methods for analysis of the costs of library inputs and the overall costs of library services. It would be valuable to continue to explore the application of the sophisticated econometric models to the analysis of library costs and services. It could ultimately lead to a better understanding of the processes of resource allocation in local public libraries and to results on the distribution of access to quality library services throughout local communities in the United States. The kinds of econometric models applied in this report have the potential to address the factors underlying differences in the demand for library services: the role played by local community characteristics (e.g., income and education levels of the local community), as well as the impact of federal and state grants on library spending and service levels. All of these factors are important dimensions of library services and in the determination of the variations in the costs of public library services across local communities and over time. Further work on resource allocation in public libraries might focus on the following kinds of questions:

- What is the nature of geographic differences in the costs of library services? What are the implications of the observed geographic differences in library costs for the levels of services in different communities throughout the U.S.?

- What kinds of resources are being allocated to different library programs? What are the quantities and characteristics of the resources being utilized in different types of communities?

- How well do various library programs and services relate to community needs? What are the disparities in library programs and services among various types of communities?

- What are the differences in the costs of various library personnel? How do these differences vary by the personal background, professional qualifications, and working conditions of personnel?

- How do patterns of resource allocation and utilization vary by library size? Are there economies of scale with larger libraries, or increased costs of bureaucracy?

Both the PLICI and the PLCSI have advantages and disadvantages in trying to measure inflation, and these have been discussed extensively in this report. Continued research would improve both approaches, and the authors would recommend using both of these measures of inflation with caution and with a full understanding of the limitations and advantages of each. They are both attempts to measure the cost of public library services, but each approach places emphasis in different places: one on inputs (PLICI) and one on library services (PLCSI).

The PLICI requires more detailed and diverse data sources, while the PLCSI requires more sophisticated and complex methodology. The PLICI is simpler to understand for the lay person, but represents only an approximation to a *true* cost of services index because of the simple assumptions (the fixed budget shares) used in the calculation.

The PLCSI is more difficult to understand for the lay-person, but it, in concept, has the potential of estimating the *true* cost difference. However, the PLCSI's potential weakness may lie in the difficulty of fully capturing the concept of public library outputs in the list of library services currently available. Yet a more detailed list of services may simply complicate an already complex analysis.

Glossary of Terms

Economic Terms

Budget

As used in this report (and by economists), a budget is the total combined amount allocated to be spent on a collection of items by a consumer or agency during a specific interval of time (the "time horizon"). If none of the available budget is saved for use after the time horizon, the budget is equal to the amount spent during that time horizon. This report assumes that libraries on average do not save portions of their non-capital budget for use after the time horizon.

Cost

The amount paid by an individual or agency to obtain a specific item of a fixed level of quality. This may also refer to the amount paid by an agency to obtain the services of an employee with a fixed set of qualifications.

Non-capital operating expenditures

Non-capital operating expenditures reflect the amounts paid for all purchased inputs on behalf of an agency (e.g., a library) to provide necessary services during some interval of time (e.g., a fiscal year). The term generally indicates that capital outlay for facilities are not included in this definition of expenditure. Operating expenditures, as defined by FSCS, may include some capital outlays. As defined by FSCS, the scope of capital outlay expenditures within the operating expenditure category depends upon local accounting practices.

Level of library services

Level of library services is the quantity of outputs (e.g., circulation and references) produced by a library.

Library outputs

Library outputs are services produced by a library, such as reference service and circulation.

Revenue

Funds received by an agency from an external source (e.g., a higher level of government or local taxpayers) and available during some interval of time to cover operating expenditures. For households, the term "income" rather than "revenue" is often used.

True cost	True cost is the minimum expenditure required to achieve a certain outcome.
Unit price	Unit price is the amount paid by an individual or agency to purchase a specific amount of an item regardless of the level of quality of the item. Unit prices of specific items may vary because of the quality of the item or other factors that reflect the cost of producing an item of a given level of quality.

Statistical and Mathematical Terms

Control variables	Control variables are a subset of the explanatory or independent variables which are included to make sure that the analyst is not inappropriately attributing variations in a dependent variable such as expenditures to another independent variable. For example, to isolate the impact of variations in input prices on expenditures, it is necessary to control for (or hold constant) the effects of variations in the level of services. Similarly, to isolate the impact of variations in level of services on expenditures, it is necessary to control for the effects of variations in input prices. In each case, one subset of explanatory variables is included to permit the analyst to isolate to the degree possible the effects of other explanatory variables.
Continuous variables	A continuous variable is one that can take on all numerical values, fractions or whole integers, over some defined interval. For example, an index may take on any value between 0 and infinity.
Dependent variable	A dependent variable is one whose behavior or patterns of variation are to be explained.
Dichotomous variables	These are variables that can be assigned a value of 1 or 0 depending upon whether a particular attribute or characteristic is present or is applicable. For example, locational indicators are measured as dichotomous variables which take on the value of 1 if a public library is located in a particular state or type of metropolitan or non-metropolitan area and a value of 0 if it is not.
Explanatory (or independent) variable	Variables that are included in a statistical analysis which are intended to help explain the patterns of variation in a dependent variable. Some of these explanatory or independent variables may be measured as dichotomous variables (e.g., the locational indicators).

Logarithmic form and the natural logarithm

A logarithm is the power to which a given base must be raised to obtain a particular number. For example, suppose that the base is equal to the natural base (approximately equal to 2.718281828) and that the natural base is raised to the power of 2. Consequently, two is equal to the natural logarithm of the square of 2.718281828. Logarithmic form is a specification of a mathematical equation in which the logarithm of several variables on the right-hand-side of the equal sign are summed to equal the logarithm of the variable on the left-hand-side of the equal sign. All logarithmic forms in this report make use of the natural logarithm.

Pearson correlation coefficient

The Pearson correlation coefficient is a measure of the extent to which two variables are linearly related. Correlations may range from a value of one, representing a perfectly positive linear relationship, to a value of negative one, representing a perfectly negative linear relationship. Two variables are not linearly related if the Pearson correlation is zero.

Regression analysis, regression models, and econometric analysis

Regression analysis is a type of statistical analysis used to examine the relationship between a particular variable (the dependent variable) and one or more other variables (independent variables). Typically, regression models are represented by linear equations such as $Y = a + bX + cZ + \ldots$, in which Y represents the dependent variable, X and Z represent independent variables, and b and c represent regression coefficients. The coefficients measure the change in the dependent variable caused by a one-unit increase in an independent variable, holding other independent variables constant. The use of regression analysis relies on certain assumptions. For example, it is assumed that the fit of the model does not vary with the value of the independent variables; econometric analysis is sometimes used to take into account cases in which these assumptions may not hold. Weighted least squares (WLS) regression analysis is an example of an econometric analysis that attempts to account for cases in which the fit of the model varies with the value of the independent variables. Two-stage least squares 2(SLS) regression analysis is an example of an econometric analysis that sometimes can be used to address parameter estimation bias resulting from a correlation between the error term and an explanatory variable. These econometric techniques are not mutually exclusive. For example, this report makes use of a weighted 2SLS technique. For a thorough explanation of these and other econometric techniques, see Theil (1971).

Sensitivity analysis

The purpose of a sensitivity analysis is to examine whether the results or outcome of a particular model or methodology are sensitive to particular assumptions. For example, the PLICI framework allows one to specify fringe benefit expenditures using more than one approach. However, as shown in table 6 of the report, the overall inflation index does not appear to be sensitive to the manner in which fringe benefits are specified

Standard error

Estimates in this report are derived from sample surveys, and these estimates may vary from values obtained if one were to make use of a complete survey. Standard errors are a measure of the accuracy of estimates from sample surveys. Appendix C contains estimates of the standard errors corresponding to the tables in this report for which standard errors could be derived. In general, standard errors could only be derived if raw data were available, such as ALA data. The standard errors calculated as part of the regression analysis, however, are included in appendix B, along with the regression coefficient estimates.

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Appendix A. Technical Notes

Data Sets Used for This Project

This report made use of three major data sets. Other data used in this report were from previously published tabulations, and are described in the text.

American Library Association salary data, data years 1988–1994. This report analyzed salary data on library staff, such as directors, managerial staff, and non-supervisory professional staff (e.g., those who provide reference and cataloging services), using the American Library Association (ALA) data set. In 1986 and in each year since 1988, the ALA has sent a survey questionnaire to over 1,000 randomly selected public and academic libraries on issues pertaining to library salaries. In particular, the survey asks for salaries of each employee in various full-time staff positions such as director, deputy/associate director, department/branch head, reference librarian, children/young adult librarian, and cataloger/classifier. Among public libraries, surveys were collected from medium-sized libraries (those serving a population of between 25,000 and 99,999) and large-sized libraries (those serving a population of 100,000 or more).

Public Libraries Survey, data years 1989–1993. The regression analysis made use of the NCES Federal-State Cooperative System (FSCS) database of identifying descriptive data about public libraries. Each year, NCES and state data coordinators in the 50 states and the District of Columbia collect data on approximately 9,000 public libraries. In recent years, data on the U.S. territories were added to the FSCS data set, but these data were not used in the development of the input cost index. These data were not used for two reasons: (1) a regression analysis covering data years 1989–1993 would exclude recent data on U.S. territories since these data were not included in earlier years; (2) the territories data have not been published by NCES. Variables used in the regression analysis included the total operating expenditures and the population of the legal service area, along with library service variables (e.g., circulation, reference transactions, library visits).

County and City Data Book, 1990 (data year 1989). The regression analysis also made use of the 1989 county-level Census files. The following variables were used: the median county income, the poverty rate in the county, the median housing value in the county, and the percentage of the population in the county with a high school degree.

Defining a FMB–PLICI Using Budget Shares and Individual Input Cost Indexes

It will be demonstrated below that the FMB-PLICI can be expressed using budget shares (i.e., the proportion of the budget allocated to each input in some base time period) and individual indexes for each of the library inputs (e.g., librarians and books). The framework outlined below pertains to the PLICI developed by AIR (PLICIa) and RAW (PLICIb). Let the budget in year 1 (B_1) be defined by the following expression:

$$B_0 = W_0 L_0 + P_0 Q_0 \text{ where}$$

B_0 = the budget for a library in year 0
W_0 = wages paid to librarians in year 0
L_0 = FTE librarians employed in year 0
P_0 = price paid per book in year 0
Q_0 = quantity of books added to the libraries collection in year 0

Define

W_t = annual wages paid to librarians in year t
P_t = price paid per book in year t
B_t = amount the library would have to spend in year t to purchase the same quantities of inputs as in the base year (0).

$$B_t = W_t L_0 + P_t Q_0$$

The FMB-PLICI can be defined by the following expression for the ratio of the simulated budget in year t necessary to purchase the same inputs as in the base period 0.

$$\frac{B_t}{B_0} = \frac{(W_t L_0 + P_t Q_0)}{B_0}$$

Multiplying the first term on the right-hand side of the equation by W_0/W_0 and the second term by P_0/P_0 and manipulating terms, this expression can be rewritten as follows:

$$\frac{B_t}{B_0} = FMB - PLICI = \left(\frac{W_t}{W_0}\right)\left(\frac{W_0 L_0}{B_0}\right) + \left(\frac{P_t}{P_0}\right)\left(\frac{P_0 Q_0}{B_0}\right)$$

The terms $(W_0 T_0/B_0)$ and $(P_0 Q_0/B_0)$ represent the proportions of the library budget (i.e., the budget shares) allocated to librarians and books in the base year (0). Let these budget shares for librarians and books be defined by the expressions $LSHARE_0$ and $BSHARE_0$, respectively, and let ratios (W_t/W_0) and (P_t/P_0), which represent individual input cost indexes for each of the inputs, be defined by the expressions LWI_t and BPI_t. Then the FMB-PLICI above can be rewritten in the following form:

$$FMB - PLICI = LWI_t \times LSHARE_0 + BPI_t \times BSHARE_0$$

Table A.1— Inflation rates[1] for medium– or large–sized libraries under two assumptions pertaining to nonprint media

	Including Nonprint Media	Excluding Nonprint Media
1988–89	4.95%	5.13%
1989–90	6.42	6.44
1990–91	5.44	5.49
1991–92	4.38	4.55
1992–93	3.41	3.52
1993–94	3.55	3.56

[1] Inflation values derived from all sources listed in table 8D. Medium– and large–sized libraries refer to libraries with a population serving size of 25,000 or more.

This expression shows directly that the FMB–PLICI is simply a weighted average index of the prices of library inputs, where the weights are the budget shares of each input. This expression can easily be generalized to a long list of inputs.

The Impact of Including or Excluding the Nonprint Media Input Cost Index on the AIR–PLICIa

Below are the percentage changes in library costs for medium– or large–sized libraries, derived from the total library index. One column excludes the nonprint media category, and the other column includes this category. As shown in the table, the unreliability of the various nonprint media price series has a small effect on the total index.

Equation for the Econometric Model

The econometric model of the cost of library services is specified as a transcendental natural logarithmic cost function. (The glossary includes a definition of logarithmic, as well as a natural logarithm.) This type of model has been applied in cost studies across many industries as well as to library services by previous authors.[41] Formally, this model may be expressed as follows:

$$LnE = \alpha + \sum_i \beta_i \bullet \ln Q_i + \sum_i \sum_j \left(\tfrac{1}{2}\right) \bullet \gamma_{ij} \bullet \ln Q_i \bullet \ln Q_j + \sum_k \delta_k \bullet L_k + \sum_t \varepsilon_t \bullet Y_t + u$$

where the Greek symbols α, β_i, γ_{ij}, δ_k, and ε_t represent the coefficients, u is the error term in the regression, and

$Ln\ E$ = the natural logarithm of expenditures or expenditures per population (of the service area)

lnQ_i = the ith library output (service indicator such as circulation, library visits, or reference transactions)

L_k = the kth location indicator (state or metropolitan area)

Y_t = the dichotomous variable indicating the year

[41] See, for example, Chressanthis (1995), DeBoer (1992), Bookstein (1981), and Cooper (1979).

The base year for the analysis is 1991. The base location is New York state.

Calculation of the Index Numbers and Inflation Estimates from The Econometric Model

The index value (I_t) corresponding to each year is calculated using the value of the coefficient (ε_t) on the dichotomous variable for the year (Y_t) as follows:

$$I_t = 100 \times \exp(\varepsilon_t)$$

Thus, for example, a coefficient on the year 1989 dichotomous variable of -0.089737 (See table B.3) yields an index of 91.42. The coefficient for 1990 using the same regression table is -0.031514 and results in an index of 96.90. The inflation rate (R_t) between 1989 and 1990 is calculated using the following formula:

$$R_{t+1} = \frac{(I_{t+1} - I_t)}{I_t}$$

Thus, the inflation rate in the example would be as follows:

$$\frac{(96.90 - 91.42)}{91.42} = 6.00\%$$

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Appendix B. Various Descriptive Statistics and Parameter Estimates for the Variables Used in the Regression Analysis

Regression Results for the Analysis of Public Library Expenditures

The dependent variable and the library service variables used in the regression analysis are specified in natural logarithmic form. (The glossary includes a definition of logarithmic, as well as a natural logarithm). Unless otherwise noted in the tables, the dependent variable is total per capita library operating expenditures (measured annually). The library service variables included: per capita library visits, per capita circulation, and the per capita number of reference transactions (all measured annually). Table B.9 is the exception with the dependent variable expressed in total operating expenditures for public library services and the output measures expressed directly as totals rather than per capita terms (e.g., total circulation rather than per capita circulation). Most of the other independent variables used in the regression analysis are specified as dichotomous variables. For example, is the library outlet located in a metropolitan area?

Table B.1— Ordinary Least Squares regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.6914 Adjusted R-sq: 0.6907

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.164692	0.02913214	39.980	0.0001
METROPOLITAN	0.142334	0.00772680	18.421	0.0001
AL	0.058193	0.03152193	-1.846	0.0649
AZ	-0.015187	0.03907284	-0.389	0.6975
AR	-0.463981	0.04370392	-10.616	0.0001
CA	0.253444	0.03440669	7.366	0.0001
CO	-0.027468	0.02446873	-1.123	0.2616
CT	0.130761	0.02726481	4.796	0.0001
DE	-0.180366	0.04082416	-4.418	0.0001
FL	-0.199346	0.03188973	-6.251	0.0001
GA	-0.126108	0.03473761	-3.630	0.0003
HI	-0.179220	0.19764621	-0.907	0.3645
ID	-0.160890	0.02712086	-5.932	0.0001
IL	0.028419	0.01871931	1.518	0.1290
IN	0.103895	0.02114232	4.914	0.0001
IA	-0.305778	0.01851262	-16.517	0.0001
KS	-0.125613	0.02054534	-6.114	0.0001
KY	-0.523446	0.02870356	-18.236	0.0001
LA	0.011771	0.03638701	0.324	0.7463
ME	-0.185229	0.02390334	-7.749	0.0001
MD	-0.040973	0.06286532	-0.652	0.5146
MA	-0.103422	0.02728526	-3.790	0.0002
MI	-0.054682	0.01976758	-2.766	0.0057
MN	-0.145158	0.02437977	-5.954	0.0001
MS	-0.220749	0.03430453	-6.435	0.0001
MO	-0.378808	0.02397406	-15.801	0.0001
MT	-0.384702	0.02861961	-13.442	0.0001
NE	-0.143360	0.02284622	-6.275	0.0001
NV	0.301006	0.04903485	6.139	0.0001
NH	0.020038	0.02159394	0.928	0.3535
NJ	0.420443	0.01975973	21.278	0.0001
NM	0.130159	0.03593194	3.622	0.0003
NY	..... *Comparison State*			
NC	-0.175838	0.02889906	-6.085	0.0001
ND	-0.521532	0.03221356	-16.190	0.0001
OH	0.050485	0.02122219	2.379	0.0174
OK	-0.220586	0.03012995	-7.321	0.0001
OR	-0.170246	0.03118545	-5.459	0.0001
PA	-0.243926	0.01888854	-12.914	0.0001
RI	0.086379	0.03943913	2.190	0.0285
SD	-0.319968	0.02810008	-11.387	0.0001
TN	-1.067678	0.02520177	-42.365	0.0001
TX	-0.392479	0.01813395	-21.643	0.0001
UT	-0.354261	0.03654565	-9.694	0.0001
VT	-0.112587	0.02580977	-4.362	0.0001
VA	-0.091637	0.03049202	-3.005	0.0027
WV	-0.559920	0.02543899	-22.010	0.0001
WI	-0.215696	0.01915925	-11.258	0.0001
WY	0.184470	0.05934802	3.108	0.0019

(continued)

Table B.1— Ordinary Least Squares regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.6914 Adjusted R-sq: 0.6907

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.094473	0.00961412	-9.826	0.0001
1990	-0.033040	0.00883989	-3.738	0.0002
1991	..... *Comparison State*			
1992	0.023537	0.00820747	2.868	0.0041
1993	0.065246	0.00819612	7.961	0.0001
visits per capita	0.371821	0.02522003	14.743	0.0001
reference transactions per capita	-0.020106	0.01739196	-1.156	0.2477
circulation per capita	0.322885	0.02434037	13.265	0.0001
visits per capita squared	0.034098	0.00175298	19.451	0.0001
visits per capita × reference transactions per capita	0.012756	0.00220458	5.786	0.0001
visits per capita × circulation per capita	-0.091096	0.00343874	-26.491	0.0001
reference transactions per capita squared	0.002512	0.00115152	2.181	0.0292
reference transactions per capita × circulation per capita	-0.009401	0.00277069	-3.393	0.0007
circulation per capita squared	0.055181	0.00266046	20.741	0.0001

Table B.2— Ordinary Least Squares regression results using library variables (circulation per capita); other independent variables (year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.6635 Adjusted R-sq: 0.6629

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.007435	0.02076693	48.512	0.0001
METROPOLITAN	0.171409	0.00800932	21.401	0.0001
AL	-0.090727	0.03288992	-2.759	0.0058
AZ	0.009525	0.04078351	0.234	0.8153
AR	-0.523879	0.04553622	-11.505	0.0001
CA	0.255359	0.03437763	7.428	0.0001
CO	0.024401	0.02549406	0.957	0.3385
CT	0.164135	0.02843096	5.773	0.0001
DE	-0.179850	0.04257370	-4.224	0.0001
FL	-0.149580	0.03323697	-4.500	0.0001
GA	-0.162721	0.03624360	-4.490	0.0001
HI	-0.138085	0.20611864	-0.670	0.5029
ID	-0.105366	0.02827850	-3.726	0.0002
IL	0.057582	0.01949778	2.953	0.0031
IN	0.091357	0.02206133	4.141	0.0001
IA	-0.319060	0.01929073	-16.540	0.0001
KS	-0.127916	0.02066895	-6.189	0.0001
KY	-0.640173	0.02968863	-21.563	0.0001
LA	-0.043930	0.03793991	-1.158	0.2469
ME	-0.183353	0.02493795	-7.352	0.0001
MD	-0.087744	0.06496421	-1.351	0.1768
MA	-0.108636	0.02845727	-3.818	0.0001
MI	-0.067131	0.02062246	-3.255	0.0011
MN	-0.140469	0.02543552	-5.523	0.0001
MS	-0.209443	0.03579230	-5.852	0.0001
MO	-0.403403	0.02499703	-16.138	0.0001
MT	-0.436992	0.02956867	-14.779	0.0001
NE	-0.108338	0.02383359	-4.546	0.0001
NV	0.299598	0.05116895	5.855	0.0001
NH	0.028317	0.02253706	1.256	0.2090
NJ	0.475845	0.02055182	23.153	0.0001
NM	0.250529	0.03738235	6.702	0.0001
NY	..... Comparison Year			
NC	-0.182101	0.03016386	-6.037	0.0001
ND	-0.588851	0.03348410	-17.586	0.0001
OH	0.059527	0.02212575	2.690	0.0071
OK	-0.190045	0.03143638	-6.045	0.0001
OR	-0.220313	0.03250405	-6.778	0.0001
PA	-0.264698	0.01967655	-13.452	0.0001
RI	-0.060940	0.03581807	-1.701	0.0889
SD	-0.272656	0.02931521	-9.301	0.0001
TN	-1.157915	0.02617016	-44.246	0.0001
TX	-0.411104	0.01890647	-21.744	0.0001
UT	-0.325146	0.03812484	-8.528	0.0001
VT	-0.084282	0.02692734	-3.130	0.0018
VA	-0.155632	0.03166513	-4.915	0.0001
WV	-0.504171	0.02648252	-19.038	0.0001
WI	-0.214034	0.01999643	-10.704	0.0001
WY	0.227939	0.06194780	3.680	0.0002

(continued)

Table B.2— Ordinary Least Squares regression results using library variables (circulation per capita); other independent variables (year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual)	N: 26,420	R-squared: 0.6635	Adjusted R-sq: 0.6629

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.112518	0.00980063	-11.481	0.0001
1990	-0.045461	0.00918062	-4.952	0.0001
1991	..... Comparison Year			
1992	0.025382	0.00856567	2.963	0.0030
1993	0.072695	0.00855069	8.502	0.0001
circulation per capita	0.627137	0.00457795	136.991	0.0001
circulation per capita squared	0.003568	0.00011520	30.970	0.0001

Table B.3— Weighted Least Squares regression results using library variables (library visits per capita, circulation per capita, and reference transactions per capita); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.7071 Adjusted R-sq: 0.7064

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.209970	0.02846336	42.510	0.0001
METROPOLITAN	0.139574	0.00737518	18.925	0.0001
AL	-0.096611	0.03067727	-3.149	0.0016
AZ	-0.046068	0.03596094	-1.281	0.2002
AR	-0.488470	0.03880948	-12.586	0.0001
CA	0.187213	0.03036877	6.165	0.0001
CO	-0.057828	0.02368413	-2.442	0.0146
CT	0.124980	0.02577665	4.849	0.0001
DE	-0.207229	0.03841243	-5.395	0.0001
FL	-0.223754	0.02871788	-7.791	0.0001
GA	-0.159333	0.03060241	-5.207	0.0001
HI	-0.201469	0.15391265	-1.309	0.1906
ID	-0.196146	0.02715281	-7.224	0.0001
IL	0.028563	0.01806299	1.581	0.1138
IN	0.078651	0.02030569	3.873	0.0001
IA	-0.316939	0.01813103	-17.480	0.0001
KS	-0.126920	0.02052317	-6.184	0.0001
KY	-0.537327	0.02672480	-20.106	0.0001
LA	-0.024574	0.03299247	-0.745	0.4564
ME	-0.195099	0.02392678	-8.154	0.0001
MD	-0.065268	0.05433483	-1.201	0.2297
MA	-0.104699	0.02603178	-4.022	0.0001
MI	-0.072238	0.01885208	-3.832	0.0001
MN	-0.171612	0.02351232	-7.299	0.0001
MS	-0.245595	0.03095888	-7.933	0.0001
MO	-0.388408	0.02303729	-16.860	0.0001
MT	-0.397026	0.02834402	-14.007	0.0001
NE	-0.151554	0.02329389	-6.506	0.0001
NV	0.231219	0.04767041	4.850	0.0001
NH	0.001904	0.02145751	0.089	0.9293
NJ	0.417935	0.01869111	22.360	0.0001
NM	0.065273	0.03544250	1.842	0.0655
NY	..... *Comparison State*			
NC	-0.210118	0.02587745	-8.120	0.0001
ND	-0.523087	0.03249072	-16.100	0.0001
OH	0.024406	0.01996119	1.223	0.2215
OK	-0.251963	0.02935442	-8.583	0.0001
OR	-0.201183	0.03008573	-6.687	0.0001
PA	-0.262355	0.01795505	-14.612	0.0001
RI	0.052703	0.03734179	1.411	0.1581
SD	-0.326935	0.02856942	-11.444	0.0001
TN	-1.066224	0.02343204	-45.503	0.0001
TX	-0.415777	0.01726628	-24.080	0.0001
UT	-0.385719	0.03558566	-10.839	0.0001
VT	-0.123292	0.02610697	-4.723	0.0001
VA	-0.118740	0.02768710	-4.289	0.0001
WV	-0.573072	0.02422603	-23.655	0.0001
WI	-0.226285	0.01852970	-12.212	0.0001
WY	0.164970	0.05590323	2.951	0.0032

(continued)

Table B.3— Weighted Least Squares regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual)	N: 26,420	R-squared: 0.7071	Adjusted R-sq: 0.7064

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.089737	0.00935870	-9.589	0.0001
1990	-0.031514	0.00859035	-3.668	0.0002
1991	********** *Comparison Year* **********			
1992	0.022155	0.00797918	2.777	0.0055
1993	0.063427	0.00796253	7.966	0.0001
visits per capita	0.369740	0.02486624	14.869	0.0001
reference transactions per capita	0.005339	0.01723035	0.310	0.7567
circulation per capita	0.293857	0.02418225	12.152	0.0001
visits per capita squared	0.033112	0.00164912	20.078	0.0001
visits per capita × reference transactions per capita	0.011924	0.00215472	5.534	0.0001
visits per capita × circulation per capita	0.088927	0.00335760	-26.485	0.0001
reference transactions per capita squared	0.003644	0.00115488	3.155	0.0016
reference transactions per capita × circulation per capita	-0.012452	0.00272953	-4.562	0.0001
circulation per capita squared	0.056660	0.00262225	21.607	0.0001

Table B.4— Weighted Least Squares regression results using library variables (circulation per capita); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual)		N: 26,420	R-squared: 0.6801	Adjusted R-sq: 0.6794
Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.006111	0.02001822	50.260	0.0001
METROPOLITAN	0.168480	0.00765072	22.021	0.0001
AL	-0.125542	0.03204106	-3.918	0.0001
AZ	-0.025296	0.03757135	-0.673	0.5008
AR	-0.546770	0.04045832	-13.514	0.0001
CA	0.192091	0.03032918	6.334	0.0001
CO	-0.011404	0.02470505	-0.462	0.6444
CT	0.161348	0.02690671	5.997	0.0001
DE	-0.200820	0.04010169	-5.008	0.0001
FL	-0.179388	0.02995207	-5.989	0.0001
GA	-0.195425	0.03195094	-6.116	0.0001
HI	-0.177391	0.16064080	-1.104	0.2695
ID	-0.147137	0.02834705	-5.191	0.0001
IL	0.061965	0.01883528	3.290	0.0010
IN	0.069431	0.02120883	3.274	0.0011
IA	-0.328044	0.01891012	-17.348	0.0001
KS	-0.131101	0.02063901	-6.352	0.0001
KY	-0.649868	0.02766192	-23.493	0.0001
LA	-0.076204	0.03442958	-2.213	0.0269
ME	-0.187967	0.02498491	-7.523	0.0001
MD	-0.106365	0.05610909	-1.896	0.0580
MA	-0.104249	0.02717674	-3.836	0.0001
MI	-0.079696	0.01969052	-4.047	0.0001
MN	-0.169329	0.02455115	-6.897	0.0001
MS	-0.231387	0.03232763	-7.158	0.0001
MO	-0.415105	0.02403979	-17.267	0.0001
MT	-0.447636	0.02929215	-15.282	0.0001
NE	-0.115788	0.02432406	-4.760	0.0001
NV	0.225656	0.04979568	4.532	0.0001
NH	0.014453	0.02241407	0.645	0.5191
NJ	0.476031	0.01945264	24.471	0.0001
NM	0.175554	0.03692222	4.755	0.0001
NY	.....	*Comparison State*	.....	
NC	-0.216480	0.02702997	-8.009	0.0001
ND	-0.587351	0.03382276	-17.366	0.0001
OH	0.031940	0.02082704	1.534	0.1251
OK	-0.219361	0.03065489	-7.156	0.0001
OR	-0.250885	0.03138992	-7.993	0.0001
PA	-0.280942	0.01872278	-15.005	0.0001
RI	-0.085559	0.03346566	-2.557	0.0106
SD	-0.279377	0.02983354	-9.365	0.0001
TN	-1.153432	0.02434841	-47.372	0.0001
TX	-0.429666	0.01802460	-23.838	0.0001
UT	-0.354312	0.037[illegible]3817	-9.535	0.0001
VT	-0.091313	0.02726159	-3.350	0.0008
VA	-0.179103	0.02878150	-6.223	0.0001
WV	-0.516602	0.02523970	-20.468	0.0001
WI	-0.220272	0.01935842	-11.379	0.0001
WY	0.207051	0.05840724	3.545	0.0004

(continued)

Table B.4— Weighted Least Squares regression results using library variables (circulation per capita); other independent variables (year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.6801 Adjusted R-sq: 0.6794

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.107694	0.00957745	-11.245	0.0001
1990	-0.044110	0.00893679	-4.936	0.0001
1991	********** *Comparison Year* **********			
1992	0.023645	0.00833520	2.837	0.0046
1993	0.070702	0.00831455	8.503	0.0001
circulation per capita	0.621730	0.00449291	138.380	0.0001
circulation per capita squared	0.003794	0.00010837	35.012	0.0001

Table B.5a— Two–Stage Least Squares regression results using library variables (circulation per capita); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.3722 Adjusted R-sq: 0.3709

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.812703	0.07010196	25.858	0.0001
METROPOLITAN	0.301086	0.00986274	30.528	0.0001
AL	-0.385782	0.04487121	-8.598	0.0001
AZ	0.086182	0.05276642	1.633	0.1024
AR	-0.533112	0.05690366	-9.369	0.0001
CA	0.333272	0.04227564	7.883	0.0001
CO	-0.120619	0.03464072	-3.482	0.0005
CT	0.101083	0.03770082	2.681	0.0073
DE	-0.294182	0.05616099	-5.238	0.0001
FL	-0.213067	0.04204238	-5.068	0.0001
GA	-0.143478	0.04523539	-3.172	0.0015
HI	0.283825	0.22464215	1.263	0.2064
ID	-0.207005	0.03975932	-5.206	0.0001
IL	-0.019477	0.02647918	-0.736	0.4620
IN	0.130598	0.02986803	4.372	0.0001
IA	-0.501454	0.02699120	-18.578	0.0001
KS	-0.202382	0.02965069	-6.826	0.0001
KY	-0.482541	0.03911872	-12.335	0.0001
LA	0.071044	0.04862123	1.461	0.1440
ME	-0.489719	0.03484809	-14.053	0.0001
MD	0.191466	0.07810763	2.451	0.0142
MA	-0.154440	0.03805972	-4.058	0.0001
MI	-0.355147	0.02758427	-12.875	0.0001
MN	-0.023259	0.03447997	-0.675	0.5000
MS	-0.411930	0.04584450	-8.985	0.0001
MO	-0.416543	0.03368830	-12.365	0.0001
MT	-0.813841	0.04058247	-20.054	0.0001
NE	-0.313696	0.03443742	-9.109	0.0001
NV	0.127048	0.06976220	1.821	0.0686
NH	-0.290265	0.03115579	-9.317	0.0001
NJ	0.222904	0.02711612	8.220	0.0001
NM	0.092016	0.05172214	1.779	0.0752
NY	..... *Comparison State*			
NC	-0.099526	0.03826444	-2.601	0.0093
ND	-0.815348	0.04739366	-17.204	0.0001
OH	0.289435	0.02911430	9.941	0.0001
OK	-0.350924	0.04293261	-8.174	0.0001
OR	-0.241849	0.04402260	-5.494	0.0001
PA	-0.570206	0.02615922	-21.798	0.0001
RI	-0.242711	0.04704341	-5.159	0.0001
SD	-0.466312	0.04183426	-11.147	0.0001
TN	-1.502695	0.03431349	-43.793	0.0001
TX	-0.709508	0.02521048	-28.143	0.0001
UT	-0.333493	0.05211013	-6.400	0.0001
VT	-0.366173	0.03803713	-9.627	0.0001
VA	-0.101699	0.04048702	-2.512	0.0120
WV	-0.618756	0.03551821	-17.421	0.0001
WI	-0.262330	0.02716861	-9.656	0.0001
WY	0.350694	0.08186468	4.284	0.0001

(continued)

Table B.5a— Two-Stage Least Squares regression results using library variables (circulation per capita); other independent variables (year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.3722 Adjusted R-sq: 0.3709

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.106947	0.01350991	-7.916	0.0001
1990	-0.032626	0.01255729	-2.598	0.0094
1991	********** *Comparison Year* **********			
1992	0.028129	0.01169010	2.406	0.0161
1993	0.076885	0.01167768	6.584	0.0001
circulation per capita	0.200386	0.07528916	2.662	0.0078
circulation per capita squared	0.134456	0.02193829	6.129	0.0001

Table B.5b— First Stage Regression used in Two-Stage Least Square using library variable (circulation per capita); other independent variables (years 1989–1993)

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.8265 Adjusted R-sq: 0.8263

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	68.511740	20.79912326	3.294	0.0010
Natural log of legal serving population (POP)	-0.111742	0.29718229	-0.376	0.7069
POP squared	0.225292	0.01663206	13.546	0.0001
POP, raised to the power of three	-0.008383	0.00059385	-14.117	0.0001
POP × INC	-0.074442	0.03319058	-2.243	0.0249
POP × VAL	-0.058456	0.01199674	-4.873	0.0001
POP × HS	0.006761	0.00048728	13.875	0.0001
POP × POV	-0.002862	0.00098440	-2.907	0.0036
Natural log of median income within the county (INC)	-0.420775	5.30827202	-0.079	0.9368
INC squared	-0.116797	0.36246087	-0.322	0.7473
INC × VAL	0.564031	0.23299760	2.421	0.0155
INC × HS	-0.021934	0.00784681	-2.795	0.0052
INC × POV	-0.059468	0.01612338	-3.688	0.0002
Natural log of the median house value within the county (VAL)	-12.213116	1.56398343	-7.809	0.0001
VAL squared	0.244783	0.04952879	4.942	0.0001
VAL × HS	0.002719	0.00285280	0.953	0.3406
VAL × POV	0.081882	0.00574475	14.253	0.0001
Percentage of population with high school degrees within the county (HS)	0.143683	0.06131848	2.343	0.0191
HSsquared	0.000136	0.00006772	2.006	0.0448
HS × POV	-0.001160	0.00020456	-5.672	0.0001
Percentage of population below the poverty line within the county (POV)	-0.173755	0.13379430	-1.299	0.1941
POV squared	-0.000589	0.00023051	-2.557	0.0106
Operating income from state government (STGVT)	7.864468E-8	0.00000001	6.112	0.0001
Operating income from federal government (FEDGVT)	-2.837064E-8	0.00000016	-0.174	0.8619
Other non-local operating income (OTHINCM)	0.000001006	0.00000005	21.527	0.0001
STGVT squared	-1.72591E-15	0.00000000	-3.956	0.0001
FEDGVT squared	-4.70998E-14	0.00000000	-1.079	0.2806
OTHINCM squared	-1.31759E-13	0.00000000	-17.540	0.0001
1989	-0.080606	0.01420379	-5.675	0.0001
1990	-0.054074	0.01333650	-4.055	0.0001
1991	..... Comparison Year			
1992	0.031829	0.01254602	2.537	0.0112
1993	0.048968	0.01249475	3.919	0.0001

Table B.6— Weighted Least Squares regression results using library variables (visits, circulation, reference transactions); other independent variables (state, metropolitan status, and year 1989–1993) for all libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.9347 Adjusted R-sq: 0.9346

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	3.178189	0.12290291	25.859	0.0001
METROPOLITAN	0.158708	0.00806463	19.679	0.0001
AL	0.028490	0.03342601	0.852	0.3940
AZ	0.011442	0.03924435	0.292	0.7706
AR	-0.240546	0.04218884	-5.702	0.0001
CA	0.204425	0.03314311	6.168	0.0001
CO	-0.084499	0.02584521	-3.269	0.0011
CT	0.136622	0.02815264	4.853	0.0001
DE	-0.072322	0.04190360	-1.726	0.0844
FL	-0.097377	0.03128202	-3.113	0.0019
GA	0.093538	0.03317289	2.820	0.0048
HI	-0.217500	0.16833894	-1.292	0.1964
ID	-0.300892	0.02960708	-10.163	0.0001
IL	-0.050224	0.01967714	-2.552	0.0107
IN	0.000739	0.02213016	0.033	0.9734
IA	-0.435724	0.01971748	-22.098	0.0001
KS	-0.346750	0.02221182	-15.611	0.0001
KY	-0.417155	0.02911507	-14.328	0.0001
LA	0.131094	0.03595058	3.646	0.0003
ME	-0.216958	0.02617428	-8.289	0.0001
MD	-0.054033	0.05937792	-0.910	0.3628
MA	-0.101443	0.02842983	-3.568	0.0004
MI	-0.002922	0.02056754	-0.142	0.8870
MN	-0.282068	0.02563142	-11.005	0.0001
MS	0.066098	0.03353877	1.971	0.0488
MO	-0.382687	0.02514476	-15.219	0.0001
MT	-0.396169	0.03093738	-12.806	0.0001
NE	-0.343024	0.02538124	-13.515	0.0001
NV	0.258093	0.05202692	4.961	0.0001
NH	-0.029604	0.02346652	-1.262	0.2071
NJ	0.479163	0.02047614	23.401	0.0001
NM	0.031926	0.03870071	0.825	0.4094
NY	********** *Comparison State* **********			
NC	-0.019538	0.02809831	-0.695	0.4869
ND	-0.565203	0.03546604	-15.936	0.0001
OH	-0.080054	0.02173813	-3.683	0.0002
OK	-0.234663	0.03203914	-7.324	0.0001
OR	-0.247091	0.03285063	-7.522	0.0001
PA	-0.119551	0.01949329	-6.133	0.0001
RI	0.217088	0.04072422	5.331	0.0001
SD	-0.435298	0.03119448	-13.954	0.0001
TN	-0.760464	0.02521005	-30.165	0.0001
TX	-0.284968	0.01876350	-15.187	0.0001
UT	-0.452787	0.03882433	-11.662	0.0001
VT	-0.168488	0.02855212	-5.901	0.0001
VA	0.005059	0.03015814	0.168	0.8668
WV	-0.467959	0.02643323	-17.703	0.0001
WI	-0.291940	0.02019892	-14.453	0.0001
WY	0.121360	0.06101279	1.989	0.0467

(continued)

Table B.6— Weighted Least Squares regression results using library variables (visits, circulation, reference transactions); other independent variables (year 1989–1993) for all libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual)	N: 26,420	R-squared: 0.9347	Adjusted R-sq: 0.9346

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.067286	0.01020837	-6.591	0.0001
1990	-0.019355	0.00937371	-2.065	0.0390
1991	**********	*Comparison Year*	**********	
1992	0.012934	0.00870772	1.485	0.1375
1993	0.050071	0.00868785	5.763	0.0001
visits	0.465229	0.02790400	16.672	0.0001
reference transactions	0.036374	0.02025234	1.796	0.0725
circulation	0.102867	0.03354969	3.066	0.0022
visits squared	0.041859	0.00179622	23.304	0.0001
visits × reference transactions	0.013659	0.00236468	5.776	0.0001
visits × circulation	-0.112204	0.00370403	-30.293	0.0001
reference transactions squared	0.006639	0.00125960	5.271	0.0001
reference transactions × circulation	-0.019816	0.00302153	-6.558	0.0001
circulation squared	0.088694	0.00296634	29.900	0.0001

Table B.7— Weighted Least Squares Regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (state, metropolitan status, and year 1989–1993) for small libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.6895 Adjusted R-sq: 0.6886

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.108315	0.03982696	27.828	0.0001
METROPOLITAN	0.150522	0.00905631	16.621	0.0001
AL	-0.004884	0.03630805	-0.135	0.8930
AZ	-0.006566	0.05619358	-0.117	0.9070
AR	-0.356289	0.08474737	-4.204	0.0001
CA	0.994850	0.07649081	13.006	0.0001
CO	0.004257	0.02896391	0.147	0.8831
CT	0.086184	0.03247086	2.654	0.0080
DE	-0.191500	0.04730310	-4.048	0.0001
FL	-0.108592	0.04545624	-2.389	0.0169
GA	0.093890	0.07234756	1.298	0.1944
ID	-0.161863	0.03135689	-5.162	0.0001
IL	0.018434	0.02249233	0.820	0.4125
IN	0.116242	0.02514904	4.622	0.0001
IA	-0.308234	0.02213250	-13.927	0.0001
KS	-0.108287	0.02438567	-4.441	0.0001
KY	-0.574303	0.03434551	-16.721	0.0001
LA	0.199177	0.04920360	4.048	0.0001
ME	-0.178439	0.02742986	-6.505	0.0001
MD	0.177527	0.18474761	0.961	0.3366
MA	-0.115186	0.03193713	-3.607	0.0003
MI	-0.066159	0.02377157	-2.783	0.0054
MN	-0.122944	0.02961805	-4.151	0.0001
MS	-0.279352	0.05957352	-4.689	0.0001
MO	-0.366847	0.02824867	-12.986	0.0001
MT	-0.367882	0.03224396	-11.409	0.0001
NE	-0.125019	0.02669154	-4.684	0.0001
NV	0.395403	0.06055834	6.529	0.0001
NH	0.041452	0.02513815	1.649	0.0992
NJ	0.379502	0.02402799	15.794	0.0001
NM	0.176783	0.04201426	4.208	0.0001
NY	..... *Comparison State*			
NC	0.116825	0.07366888	1.586	0.1128
ND	-0.505995	0.03692123	-13.705	0.0001
OH	0.085277	0.02613546	3.263	0.0011
OK	-0.206606	0.03437333	-6.011	0.0001
OR	-0.171087	0.03787053	-4.518	0.0001
PA	-0.239163	0.02305234	-10.375	0.0001
RI	0.038074	0.04663478	0.816	0.4143
SD	-0.307454	0.03188373	-9.643	0.0001
TN	-1.187344	0.03143965	-37.766	0.0001
TX	-0.389065	0.02218896	-17.534	0.0001
UT	-0.352694	0.04100666	-8.601	0.0001
VT	-0.100496	0.02927372	-3.433	0.0006
VA	-0.064615	0.04512891	-1.432	0.1522
WV	-0.582902	0.03014630	-19.336	0.0001
WI	-0.225289	0.02287524	-9.849	0.0001
WY	0.159698	0.06740345	2.369	0.0178

(continued)

Table B.7— Weighted Least Squares Regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (year 1989–1993) for small libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual)		N: 26,420	R-squared: 0.6895	Adjusted R-sq: 0.6886
Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.104446	0.01103050	-9.469	0.0001
1990	-0.037547	0.01014999	-3.699	0.0002
1991	**********	*Comparison Year*	**********	**********
1992	0.024987	0.00941827	2.653	0.0080
1993	0.068996	0.00941262	7.330	0.0001
visits per capita	0.298653	0.03513466	8.500	0.0001
reference transactions per capita	-0.008777	0.02348580	-0.374	0.7086
circulation per capita	0.392456	0.03264193	12.023	0.0001
visits per capita squared	0.034690	0.00209100	16.590	0.0001
visits per capita × reference transactions per capita	0.013721	0.00259260	5.293	0.0001
visits per capita × circulation per capita	-0.084584	0.00450850	-18.761	0.0001
reference transactions per capita squared	0.000651	0.00128194	0.508	0.6114
reference transactions per capita ×circulation per capita	-0.009641	0.00344032	-2.802	0.0051
circulation per capita squared	0.049247	0.00346763	14.202	0.0001

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Table B.8— Weighted Least Squares regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (state, metropolitan status, and year 1989–1993) for medium and large libraries

Dependent Variable: Total Operating Expenditures per Capita (annual) N: 26,420 R-squared: 0.7970 Adjusted R-sq: 0.7948

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
INTERCEPT	1.848462	0.06263855	29.510	0.0001
METROPOLITAN	0.107090	0.01207992	8.865	0.0001
AL	-0.407040	0.05532859	-7.357	0.0001
AZ	-0.072701	0.04188151	-1.736	0.0826
AR	-0.537682	0.04014894	-13.392	0.0001
CA	0.055893	0.03224033	1.734	0.0830
CO	-0.191916	0.03930324	-4.883	0.0001
CT	0.223531	0.03907225	5.721	0.0001
DE	-0.254088	0.05988696	-4.243	0.0001
FL	-0.292036	0.03358539	-8.695	0.0001
GA	-0.233042	0.03211392	-7.257	0.0001
HI	-0.153350	0.13555926	-1.131	0.2580
ID	-0.242148	0.05934809	-4.080	0.0001
IL	0.197319	0.03057812	6.453	0.0001
IN	0.030074	0.03297223	0.912	0.3618
IA	-0.152324	0.04185776	-3.639	0.0003
KS	-0.097329	0.05331878	-1.825	0.0680
KY	-0.416705	0.03860010	-10.795	0.0001
LA	-0.224080	0.03985394	-5.623	0.0001
ME	0.143832	0.09039255	1.591	0.1116
MD	-0.084330	0.05258594	-1.604	0.1088
MA	-0.056187	0.04187397	-1.342	0.1797
MI	-0.033175	0.02977190	-1.114	0.2652
MN	-0.237594	0.03508675	-6.772	0.0001
MS	-0.291033	0.03383904	-8.601	0.0001
MO	-0.385605	0.03793317	-10.165	0.0001
MT	-0.487623	0.06901321	-7.066	0.0001
NE	-0.246391	0.09281931	-2.655	0.0080
NV	-0.048761	0.06913284	-0.705	0.4806
NH	-0.264021	0.06303788	-4.188	0.0001
NJ	0.511110	0.02742129	18.639	0.0001
NM	-0.207165	0.06192555	-3.345	0.0008
NY	..... *Comparison State*			
NC	-0.279169	0.02767873	-10.086	0.0001
ND	-0.507793	0.07342474	-6.916	0.0001
OH	-0.021229	0.02824559	-0.752	0.4523
OK	-0.330575	0.05639765	-5.862	0.0001
OR	-0.205127	0.04482136	-4.577	0.0001
PA	-0.262995	0.02671842	-9.843	0.0001
RI	0.182484	0.06205963	2.940	0.0033
SD	-0.135869	0.09811148	-1.385	0.1662
TN	-0.890213	0.03192340	-27.886	0.0001
TX	-0.446951	0.02573211	-17.369	0.0001
UT	-0.451584	0.07037198	-6.417	0.0001
VT	0.435808	0.15459607	2.819	0.0048
VA	-0.155959	0.03210921	-4.857	0.0001
WV	-0.481785	0.03785195	-12.728	0.0001
WI	-0.111059	0.03292130	-3.373	0.0007
WY	0.219170	0.09104249	2.407	0.0161

(continued)

Table B.8— Weighted Least Squares regression results using library variables (visits per capita, circulation per capita, and reference transactions per capita); other independent variables (year 1989-1993) for medium and large libraries—Continued

Dependent Variable: Total Operating Expenditures per Capita (annual)	N: 26,420	R-squared: 0.7970	Adjusted R-sq: 0.7948

Variable	Parameter Estimate	Standard Error	T for HO: Parameter = 0	Prob > |T|
1989	-0.059951	0.01606898	-3.731	0.0002
1990	-0.015835	0.01457556	-1.086	0.2773
1991	..... *Comparison Year*			
1992	0.010542	0.01356107	0.777	0.4370
1993	0.046598	0.01348102	3.457	0.0006
visits per capita	0.163712	0.05616293	2.915	0.0036
reference transactions per capita	0.403929	0.05099345	7.921	0.0001
circulation per capita	0.045197	0.05514074	0.820	0.4124
visits per capita squared	0.020198	0.00246386	8.198	0.0001
visits per capita × reference transactions per capita	0.008167	0.00424275	1.925	0.0543
visits per capita × circulation per capita	-0.050807	0.00644349	-7.885	0.0001
reference transactions per capita squared	0.015407	0.00273337	5.637	0.0001
reference transactions × circulation	-0.054867	0.00584129	-9.393	0.0001
circulation squared	0.063467	0.00455960	13.920	0.0001

Elasticity

The coefficients in the above regression equations represent the change in the dependent variable caused by a one-unit increase in an independent variable, holding other independent variables constant. Another way of showing the relationship between the dependent variable and an independent variable is by using the concept of elasticity. In particular, elasticity represents the percentage change in the dependent variable that is caused by a 1 percentage increase in an independent variable, holding other independent variables constant. Table B.9 shows the percentage change in per capita total operating expenditures (annual) caused by a percentage rise in the per capita library service variables, as derived by the regression analysis.

Table B.9— Percentage increase in total public library operating expenditures per capita resulting from a one percent increase in various library service variables (i.e., the elasticity), holding the other library service variables constant

Methodology[1]	OLS	OLS	WLS	WLS	2SLS
Library Services Variables[2]	Circulation per Capita Ref Trans per Capita Visits per Capita	Circulation per Capita	Circulation per Capita Ref Trans per Capita Visits per Capita	Circulation per Capita	Circulation per Capita
Circulation per Capita	0.51%	0.70%	0.51%	0.70%	3.04%
Reference Transactions per Capita	0.05	--	0.05	--	--
Visits per Capita	0.18	--	0.18	--	--

(--) Not applicable.
[1] "OLS" is Ordinary Least Squares, "WLS" is Weighted Least Squares, and "2SLS" is Two-Stage Least Squares. All of the WLS and 2SLS regression analyses were weighted by the population of the legal service area.
[2] "Circulation" is the annual number of circulation transactions. "Ref Trans" is the total annual number of reference transactions. "Visits" is the annual number of visits to the library. "Per Capita" refers to the population of the legal service area. The variables are specified in a logarithmic form.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, *Public Libraries Survey*, Fiscal Year 1989-1993; U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *County and City Data Book, 1990*.

Correlation Matrix

Table B.10 shows the Pearson correlation coefficients between the variables used in the regression analysis. The Pearson correlation coefficient is a measure of the extent to which two variables are linearly related. Correlations may range from a value of one, representing a perfectly positive linear relationship, to a value of negative one, representing a perfectly negative linear relationship. Two variables are not linearly related if the Pearson correlation is zero.

All of the correlations in table B.10 are statistically significant at better than the 1 percent level. Moreover, all of the correlations among circulation, library visits, and reference transactions are above 0.80. The correlations with the interlibrary loan transactions range from .61 to .72.

Table B.10— Pearson correlations between natural logarithm of total operating expenditures (annual) and the natural logarithm of various library services variables[1]

	Total operating expenditures (TOTEXP)	Circulation transactions (CIRC)	Visits (VISIT)	Reference transactions (REF)	Interlibrary loan transactions (LOAN)
Total operating expenditures (TOTEXP)	1.00000 0.0 26,421				
Circulation transactions (CIRC)	0.94306 0.0001 26,421	1.00000 0.0 26,453			
Visits (VISIT)	0.87508 0.0001 26,421	0.88521 0.0001 26,453	1.00000 0.0 26,453		
Reference transactions (REF)	0.81927 0.0001 26,421	0.81860 0.0001 26,453	0.81768 0.0001 26,453	1.00000 0.0 26,453	
Interlibrary loan transactions (LOAN)	0.71828 0.0001 24,909	0.71638 0.0001 24,926	0.66142 0.0001 24,926	0.61285 0.0001 24,926	1.00000 0.0 24,926

[1] "TOTEXP" is the annual operating expenditures. "CIRC" is the annual number of transactions. "REF" is the total number of reference transactions. "VISIT" is the annual number of visits to the library. "LOAN" is the annual number of interlibrary loan transactions. The variables are specified in a logarithmic form. The correlation table includes the probability value that the correlation significantly differs from zero, along with the number of observations.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Federal-State Cooperative System for Public Library Data, *Public Libraries Survey*, Fiscal Years 1989-1993.

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Appendix C. Standard Errors

Estimates in this report are derived from sample surveys, and these estimates may vary from values obtained if one were to make use of a complete survey. Standard errors are a measure of the accuracy of estimates from sample surveys. This appendix contains estimates of the standard errors corresponding to the tables in this report for which standard errors could be derived. In general, standard errors could only be derived if raw data were available, such as ALA data. The standard errors calculated as part of the regression analysis, however, are included in appendix B, along with the regression coefficient estimates.

Table C.1— Standard errors for table 8A: Public library input cost index-medium–sized libraries[1]

Type of Expenditure (Source: table 8D)	Input Cost Index Standard Errors (1991 = 100)						
	1988	1989	1990	1991	1992	1993	1994
Personnel Compensation							
Salaries and Wages							
Library directors (1)	0.120	0.118	0.112	0.111	0.120	0.117	0.121
Other managerial staff (1)	0.128	0.106	0.101	0.101	0.108	0.112	0.112
Non-supervisory professional staff (1)	0.096	0.091	0.088	0.091	0.092	0.108	0.105
Support staff (2)	--	--	--	--	--	--	--
Fringe Benefits (3)	--	--	--	--	--	--	--
Acquisitions							
Printed Media							
Books and periodicals (4)	--	--	--	--	--	--	--
Other serials (e.g., newspapers) (5)	--	--	--	--	--	--	--
Other printed materials	--	--	--	--	--	--	--
Nonprint media							
Microforms (6)	--	--	--	--	--	--	--
Audio recordings (7)	--	--	--	--	--	--	--
Video (7)	--	--	--	--	--	--	--
CD-ROM (8)	--	--	--	--	--	--	--
Graphic images	--	--	--	--	--	--	--
Access (or on-line computer) services	--	--	--	--	--	--	--
Other Operating Expenditures							
Office Operations							
Office expenditures (9)	--	--	--	--	--	--	--
Supplies and materials (10)	--	--	--	--	--	--	--
Noncapital equipment (10)	--	--	--	--	--	--	--
Utilities (10)	--	--	--	--	--	--	--
Contracted Services (11)	--	--	--	--	--	--	--
Total Input Cost Index	--	--	--	--	--	--	--

(--) Unable to derive since raw data were not available.
[1] Libraries serving a legal service area of 25,000-99,999 persons.
SOURCES: Refer to table 8D, 1-11.

Table C.2— Standard errors for table 8B: Public library input cost index-large-sized libraries[1]

Type of Expenditure (Source: table 8D)	Input Cost Index Standard Errors (1991 = 100)						
	1988	1989	1990	1991	1992	1993	1994
Personnel Compensation							
Salaries and Wages							
Library directors (1)	0.117	0.117	0.120	0.120	0.119	0.118	0.111
Other managerial staff (1)	0.087	0.073	0.070	0.069	0.072	0.071	0.071
Non-supervisory professional staff (1)	0.076	0.060	0.058	0.058	0.056	0.062	0.063
Support staff (2)	--	--	--	--	--	--	--
Fringe Benefits (3)	--	--	--	--	--	--	--
Acquisitions							
Printed Media							
Books and periodicals (4)	--	--	--	--	--	--	--
Other serials (e.g., newspapers) (5)	--	--	--	--	--	--	--
Other printed materials	--	--	--	--	--	--	--
Nonprint media							
Microforms (6)	--	--	--	--	--	--	--
Audio recordings (7)	--	--	--	--	--	--	--
Video (7)	--	--	--	--	--	--	--
CD-ROM (8)	--	--	--	--	--	--	--
Graphic images	--	--	--	--	--	--	--
Access (or on-line computer) services	--	--	--	--	--	--	--
Other Operating Expenditures							
Office Operations							
Office expenditures (9)	--	--	--	--	--	--	--
Supplies and materials (10)	--	--	--	--	--	--	--
Noncapital equipment (10)	--	--	--	--	--	--	--
Utilities (10)	--	--	--	--	--	--	--
Contracted Services (11)	--	--	--	--	--	--	--
Total Input Cost Index	--	--	--	--	--	--	--

(--) Unable to derive since raw data were not available.
[1] Libraries serving a legal service area of 100,000 or more persons.
SOURCES: Refer to table 8D, 1-11.

Table C.3— Standard errors for table 8C: Public library input cost index-medium– or large–sized libraries[1]

Type of Expenditure (Source: table 8D)	Input Cost Index Standard Errors (1991 = 100)						
	1988	1989	1990	1991	1992	1993	1994
Personnel Compensation							
Salaries and Wages							
Library directors (1)	0.092	0.087	0.087	0.086	0.090	0.089	0.087
Other managerial staff (1)	0.079	0.065	0.063	0.062	0.064	0.063	0.063
Non-supervisory professional staff (1)	0.064	0.054	0.054	0.053	0.053	0.056	0.056
Support staff (2)	--	--	--	--	--	--	--
Fringe Benefits (3)	--	--			--	--	--
Acquisitions							
Printed Media							
Books and periodicals (4)	--	--	-		--	--	--
Other serials (e.g., newspapers) (5)	--	--	-		--	--	--
Other printed materials	--	--	--	--	--	--	--
Nonprint media							
Microforms (6)	--	--	--	--	--	--	--
Audio recordings (7)	--	--	--	--	--	--	--
Video (7)	--	--	--	--	--	--	--
CD-ROM (8)	--	--	--	--	--	--	--
Graphic images	--	--	--	--	--	--	--
Access (or on-line computer) services	--	--	--	--	--	--	--
Other Operating Expenditures							
Office Operations							
Office expenditures (9)	--	--	--	--	--	--	--
Supplies and materials (10)	--	--	--	--	--	--	--
Noncapital equipment (10)	--	--	--	--	--	--	--
Utilities (10)	--	--	--	--	--	--	--
Contracted Services (11)	--	--	--	--	--	--	--
Total Input Cost Index	--	--	--	--	--	--	--

(--) Unable to derive since raw data were not available.
[1] Libraries serving a legal service area of 25,000 or more persons.
SOURCES: Refer to table 8D, 1-11.

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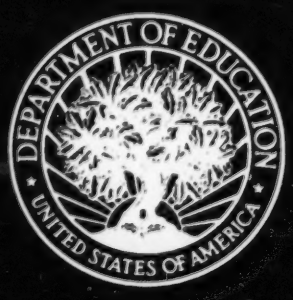

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